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ENGINEERING AND
MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

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Ore Genesis and Oreshoots

By Carlton D. Hulin

Mining Magnetite in the Mineville District

By A. M. Cummings

Solving a Fume Problem

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Volume 127 *Number 6*

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A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

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New York, February 9, 1929

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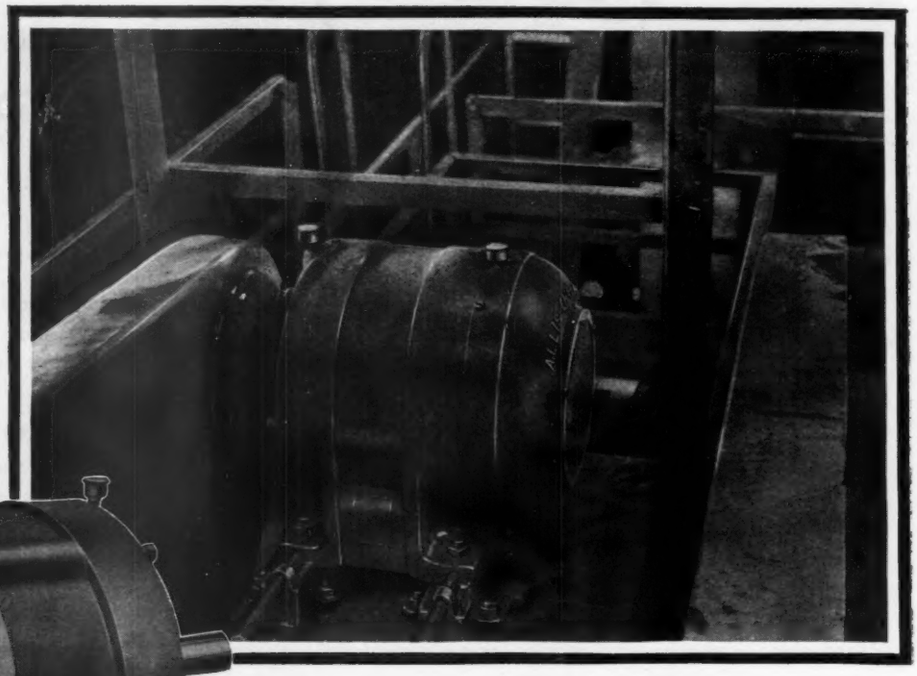

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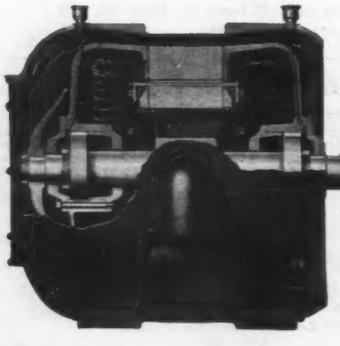

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VOLUME 127 — *New York, February 9, 1929* — NUMBER 6

The Legal Status of Xanthate in Flotation

THE widespread use of xanthate in flotation operations suggests a careful consideration of its patent status. Minerals Separation reverted to its Keller patent to obtain royalties from users of xanthate after the expiration in 1927 of its soluble frothing-agent patent. Prior to the Bourquin decision at Butte in 1928, in the trial for alleged infringement by Anaconda of the Perkins patent of Metals Recovery, users of xanthate apparently had to pay royalties to Minerals Separation, or else to Metals Recovery, assuming the Perkins patent for organic reagents were held to cover xanthate. But when the Perkins patent was held invalid in the Anaconda case, an additional complicating factor was introduced. Not only was the Perkins patent held invalid because it was too broad in scope—Anaconda's principal defensive argument—but the second argument of the defense was likewise upheld: that the work done by Mr. R. B. Martin at the Utah Copper property in 1915 constituted a prior discovery of the usefulness of xanthate in flotation. Thus was revealed unsuspected weakness in the Keller patent, which had been granted even later than that of Perkins.

Forthwith, Metals Recovery appealed from the Bourquin decision for a re-hearing in the Appellate Court. However, the opinion filed January 14, 1929, by the United States Circuit Court of Appeals for the Ninth Circuit, in San Francisco, upheld the decision. Again the Perkins patent was held invalid because of its scope, and again the court took the trouble to point out, specifically, "that xanthate, the alleged infringing agent employed by defendant, does not fall within the patent claims, fairly interpreted, and that it was discovered by one Martin approximately two years prior to the claimed date of Perkins' invention . . . " This decree, of course, is binding, unless Metals Recovery should appeal the case to a higher court and succeed in having the decision reversed. Metals Recovery reports that it has not yet decided what further action, if any, it will take.

An unusual feature of the Perkins patent litigation has been the virtual paralleling of the interests of Minerals Separation and of Metals Recovery, the Callow group—bitter adversaries in other flotation litigation. Undoubtedly, Minerals Separation watched the progress of the Metals Recovery *vs.* Anaconda case with keen interest, particularly when Anaconda decided to utilize the Martin prior-discovery defense. Metals Recovery, likewise, was greatly concerned over Bourquin's acceptance of the Martin defense, a viewpoint that was aggressively outlined by Mr. J. M. Callow in the June 2, 1928, issue of *Engineering and Mining Journal*. The picture of these two flotation litigants—adversaries in past legal encounters—engaged in combat with a common foe is a modern example of the fact that adversity makes strange bedfellows.

The latest kink in this complex situation is the news that Mr. Martin is endeavoring to establish rights to patent recognition in the United States Patent Office. Under present circumstances the Keller patent appears to have a precarious hold on xanthate royalties, despite the fact that it has not yet been legally disputed. The Perkins patent is thoroughly discountenanced, so far as its application to the use of xanthate is concerned, by the recent court decisions. Consequently, possibilities of a sound patent claim appear to rest largely with the decision of the Patent Office on the validity of Mr. Martin's belated claim for recognition. Just how severely he, or his sponsor, will feel inclined to treat users of xanthate, should he be granted patent rights, remains to be seen. In this connection it should be noted that Minerals Separation lays claim to any patent rights that Martin may secure, because of an assignment from Martin, said to have been made in 1916 for a substantial sum. Unless caution suggests the desirability of anticipatory insurance, no sound reason is apparent, for the time being, why a user of xanthate should pay royalty to anyone, except in instances where operators are bound by contract to make payment regardless of the ultimate validity of the patent under which they may be licensed.

Alaska's Road-Building Appropriation Would Just Scratch the Surface

TWO MILLION dollars will buy a great many pins. If pins were what the Alaska Road Commission wanted to purchase with the $2,000,000 it has asked for, the sum would suffice to supply the Territory's need of that commodity for at least several years to come. But roads and road-building, instead of pins, were in Major Elliott's mind when he presented the Commission's request for funds, and even the uninitiated will admit that the number of miles of road that can be built for a given sum is very much less than the number of pins the same amount will buy.

As road-building goes, Major Elliott has asked for a very modest amount indeed. Roads surfaced with gravel or crushed stone can hardly be built in the Territory for less than $25,000 per mile, save possibly in localities where conditions are especially favorable. Grading alone is an expensive matter. At this rate per mile, therefore, the appropriation requested originally would build just 80 miles of new road, which is only a stone's throw, so to speak, when considered in connection with Alaska's magnificent distances. The matter of the appeal for funds, then, simmers down to this: In a territory as

big as the United States east of the Mississippi River, the Territorial Road Commission would like to build in the fiscal year 1929-30 about 80 miles of road, or to maintain an equivalent mileage already built.

Assuredly this spells no extravagance. The average state in the Union spends at least $5,000,000 or $6,000,000 a year on roads, and the major states, such as Pennsylvania, as much as $60,000,000 or more. Yet the Budget Bureau has cut the amount requested to one-quarter of its original size, that is, to an amount sufficient to build about 20 miles of road. When regarded in terms of mileage, the half-million dollars recommended looks very small indeed. Still smaller do the tactics of the Bureau of the Budget appear. Intelligence cannot be discerned in them.

Inasmuch as the Senate has approved the cut made by the Bureau, by virtue of having passed the bill providing for the reduced appropriation, the Commission's only hope at the present session of getting anything like the amount it wants lies with the House.

To reduce an argument to an absurdity is one way of disposing of an opponent in debate. To reduce the road-building appropriation recommended by the Bureau of the Budget to terms of mileage is an effective way of showing up the Bureau. Unfortunately there appears to be no effective way of disposing of the Bureau.

The Shearing Season Is Again With Us

IN THE LATE SPRING, the sheep are gathered from the fields, where they have been allowed to gambol at their leisure for many months, and are herded into corrals. There the wool is expertly separated from their hides by rapacious acolytes of Mammon. This end having been attained, the bleating ovines are allowed their freedom again. For a year they lead carefree, irresponsible lives. They wander contentedly and ruminatively over hill and dale, or they huddle in convivial fellowship in their sheds, until it is again time for shearing. The cycle then continues.

To find similarities in the life of the lay mining investor is not difficult. In Canada he has just gone through a trying season. Within the last few weeks, investigations have been made by government officials into the affairs of two mining companies, and in two other instances much criticism has been leveled at the operating officials, and examinations have been made by independent engineers. This spectacle would be more amusing if it were less painful, both to the public and the mining companies involved. Frequently the accusations and counter-accusations are unjustified, having arisen because of lack of comprehension of the other viewpoint.

"If you would hold converse with me," said Voltaire, "define your terms." Unfortunately, mining terminology is not easily defined to the lay mind, and the sheepishness of the average investor is not always apparent to the miner. To speak of educating the public is easy, but the means for such education do not exist. The untrained possessor of surplus cash cannot distinguish between the various strata of rocks—or of mine promoters. Even his most cherished and accepted authorities are fallible when they discuss mining matters. A reference book, advertised as the most widely used in America, for instance, speaks blithely of "Patiño Mines & Enterprises . . . securing control of 80 per cent of the tin production of Bolivia, which is half the world's supply."

If a solution exists, it is in the more widespread adoption of the current practice of having reputable mining companies acquire prospects of promise. To the public, of course, this means that its chance of doubling the contents of its pocketbook overnight is greatly diminished. But to the mining industry, the course indicated promises a safer and saner prosperity. Last week, *Engineering and Mining Journal* published a news item announcing the acquisition of an important interest in N'Changa Copper by American Smelting & Refining. A more effective step for the rapid and efficient development of the property could hardly be taken. It is a safeguard to the investor and an assurance of thorough development.

Lessons From the Lafayette Dam Failure

THE report of the board of engineers appointed to investigate the failure of the Lafayette dam near Oakland, California, has recently been issued. The immediate cause of failure, according to the report, was the overloading of the foundation by a combination of the weight of the dam and steepness of slopes; but "the dam would have shown no weakness had it rested on a firm foundation."

Evidently, the board believes that the initial factor in failure was the squeezing out of plastic material under the dam. Although the compressed alluvium is extremely impervious, some of the water of the deeper alluvium was probably squeezed upward into the soil under the dam, and even into the material of the dam itself, thus increasing the plasticity of materials that formerly were fairly dry.

The opinion is advanced that the tightness of the clay foundation and the ability to carry vertical loads without deformation was increased by the compression to which it was subjected. The Board expresses the view that this experience will bring about a modification in generally accepted methods of design of earth dams on alluvial foundations, and a more careful study of such foundations than has generally been made heretofore.

Movement of ground masses under stress and in a readjustment to a new equilibrium is of interest to mining engineers. Under certain conditions, the penetration of soft, claylike rocks is usually accompanied by a squeezing in of the sides or an elevation of the floor of a working. The miner overcomes this by a supporting structure of sufficient strength to counteract the side and top pressures, or by a lighter structure and the easing of the ground pressure by excavating behind the supports.

In the Lafayette dam the superimposed embankment added to the stress on the soft and plastic alluvials forming the foundations. The load thus added reached a probable maximum of about eight or more tons per square foot, over and above the existing gravity stress. A compression of the material resulted. The fact that water rose in the test boreholes to a much higher level than the original ground surface indicated also that it

was squeezed out of the foundation material. Information as to the original water content of the foundation material is not obtainable, but, after the failure, material removed from the boreholes indicated that much of the foundation contains about 18 per cent by weight of water. Undoubtedly this water content increased the plasticity of the material and was a factor in the failure.

Studies of this character promise to awaken further interest in ground movement and subsidence. A need is evident for competent geological investigation and a better understanding of the results of such investigations by designing and construction engineers.

Predictions Regarding Gold Producers Go Astray

A YEAR AGO the following question was raised: "Will Canada's gold production in 1928 exceed that of the United States, the former country thereby replacing the latter as the second largest gold producer of the world?" Several individuals and agencies, including *Engineering and Mining Journal,* expressed the belief that such a happening was possible. Statistics and data concerning gold-mining operations in the Dominion at the close of 1927, and evidence of the steady decline in the gold output of the United States, seemed to indicate that the positions of the two countries among the gold producers of the world might interchange.

Canada's gold output, which, according to estimates made early in 1928, should have reached a value of about $45,000,000 for the year, totaled actually, on the basis of official estimates recently announced by the Dominion Bureau of Statistics, $38,647,000. And the decrease in production of the United States, which was 5.9 per cent for 1927 as compared with 1926, was only 0.13 per cent for 1928 compared with 1927, as revealed by statistics issued by the Bureau of the Mint.

Gold production of the Dominion did increase in 1928—by about $346,500; and that of the United States did decrease—by $58,500. But either one or both of these figures must alter substantially before the positions of the two countries among the gold producers of the world are reversed. New predictions are in order.

An Advertising Page Makes an Interesting Cycle

ARRIVED RECENTLY at this office a page from the advertising section of the issue of *Engineering and Mining Journal* of November 10, after a journey of several thousand miles and sundry transfers of ownership that prompted comment on the part of the advertiser, The Dorr Company, as to the ubiquity of its friends, the frugality of the French, and the distribution and ultimate destination of the printed word. The remarkable chain of circumstances possessed the following links:

A member of the faculty of the University of California, a friend of Mr. A. T. Hastings, of The Dorr Company's staff, was recently touring in England and the Continent. One day while in Paris he stopped to purchase some roasted chestnuts from a street vendor, which were handed to him in a paper bag. To his surprise, the bag, he found, had been made from a page torn out of an American magazine. To his greater surprise, he discovered that it displayed a Dorr advertisement on closed-circuit grinding practice at the Andes Copper plant in Chile!

The bag was sent to Mr. Hastings, then in London, who forwarded it to Mr. Dorr in New York, who courteously returned it to this office. Its success in serving a useful purpose quite different from its original mission, and in attracting international attention, is justification for the additional publicity it now receives. Rarely, if ever before, have the wanderings of a page of advertising been sufficiently interesting and unusual to justify its classification as a museum exhibit.

Co-ordinated Teamwork the Secret of Success

MANY industrial achievements were recorded in 1928, but perhaps the most outstanding and spectacular was that of the Chevrolet Motor Company. Up to October 1, this organization was completing 5,000 four-cylinder cars a day; on that date, however, this model was discontinued, and production of an entirely new six-cylinder series undertaken. Expenditures involved in making the change are said to have exceeded $30,000,000. During December about 25,000 cars of the new model were completed, and in January of the current year output exceeded 100,000 units. Capacity production of the company's plants, which is 6,000 cars a day, or 150,000 for the average month, is expected to be reached in February.

To discontinue abruptly the manufacture of cars at the rate of 5,000 a day, re-equip plants, re-train workers in the manufacture of new parts, and within about ninety days reach capacity operations on an entirely new model is a tremendous undertaking, the accomplishment of which is worthy of attention, even on the part of those in other industries where mass production methods cannot be applied as extensively as in the motor industry. Officials in other industries will be interested in the means employed efficiently to make so sweeping a manufacturing change; and on this subject Mr. W. S. Knudsen, president of the Chevrolet company, is quoted as saying: "Chevrolet is operated on a unit system. Each unit is operated by a plant manager who is in full and complete charge. He gets his problem to solve and the schedule he is exepected to meet. He may come to headquarters for policy, but, fundamentally, he does his own job and creates among his own people the enthusiasm for accomplishment without which nothing could ever be effected. In the last analysis, it was the employees of the Chevrolet company, doing their best, that enabled us to complete this great task."

Enthusiasm for accomplishment, which evidently prevailed throughout the organization, appears to have been chiefly responsible for the success achieved. Undoubtedly the same spirit of co-operation could be employed with benefit in many other industries.

Ore Genesis and Oreshoots

By CARLTON D. HULIN
Assistant Professor of Geology, University of California

Part I of this paper is essentially a synopsis of "Metallization From Basic Magmas," a University of California publication (bulletin of the Department of Geological Science) which is now in press. In consequence references have been largely omitted

Ore Genesis

ACCORDING to present-day theories of ore genesis, most vein deposits and most replacement deposits which are valuable for their content of heavy metals have formed as a direct result of igneous activity. The dependence of ore deposition on igneous activity cannot be directly proved, and it is probable that a direct proof will never be forthcoming, for in the deposit we see only the result and never the process. Studies of ore deposits throughout the world, however, have shown such a consistent association and common areal distribution of ore deposits and intrusive igneous rocks that the status of ore deposition as an after effect of igneous activity can practically be conceded.

Most geologists likewise concede that vein and replacement deposits have resulted from the action of solutions or emanations. The structures and textures of vein ores, the complex sequences of formation shown by such ores, and the effects apparent in the wall rocks, are such as could only have been produced by emanations or solutions.

The deeper-seated types of vein and replacement deposits usually occur associated with intrusive bodies of major size, batholithic masses or stocks, or the cupolas of such masses. These associated major intrusives are commonly of intermediate to acid composition, so commonly so, in fact, that many geologists have maintained that vein deposits can be derived only from intrusives of such compositions. However, in addition to the major intrusive, two groups of satellitic intrusives, one acid and one basic, are almost universally present, associated with these types of ore deposits. These satellitic intrusives usually occur as dikes, and, being of limited field importance, their study has been sadly neglected and their significance minimized.

In areas typified by epithermal veins the "major intrusive" may reasonably be inferred as being present at depth, but it is practically never exposed at the surface. In such areas, however, two groups of dikes, acid and basic, which may well be the shallow correlatives of the satellitic dikes just referred to, are again almost universally represented. My attention was first attracted to these two groups of dikes in southeastern California and adjacent parts of Nevada. Here almost every center of mineralization, whether marked by productive mines or by abandoned prospect shafts, is characterized by a host of such dikes. The dikes are apparently confined to the centers of mineralization and appear to be quite absent from the intervening and presumably unmineralized areas.

Two processes are conceivable by means of which mineralizing solutions might be set free from the original host magma. The emanations or solutions might conceivably be eliminated from the upper part of the major intrusive mass by reason of their being "squeezed out" during the crystallization. This commonly accepted view would necessitate that the mineralization occur contemporaneous with the later stages of the crystallization of the upper part of the intrusive mass. This is opposed by field evidence.

Fig. 1—Hypabyssal acid and basic dike rocks associated with the epithermal mineralization in the vicinity of Benton, Mono County, Calif. A, Rhyolite containing only a trace of ferromagnesian minerals. B, Diabase rich in ferromagnesian minerals. Both thin sections, crossed nicols, 45 diameters.

The alternative possibility is that during crystallization the volatile constituents become concentrated in the still fluid parts of the magma, being finally eliminated as end products of differentiation. In this case the mineralization would be distinctly later than the solidification of the major intrusive, and would be closely related in time to the satellitic injections which represent differentiation products of the major intrusive.

Field evidence shows conclusively that mineralization generally does not occur *until after* the injection of the acid and basic satellitic dikes. These dikes, representing as they do differentiation products of the major intrusive, could come into existence only after the major parent intrusive had largely solidified. The presence of the dikes is positive evidence that at the time of their injection the magma of the major intrusive had lost its identity as such, the still fluid phase being represented by two sub-magmas, acid and basic differentiates, having the

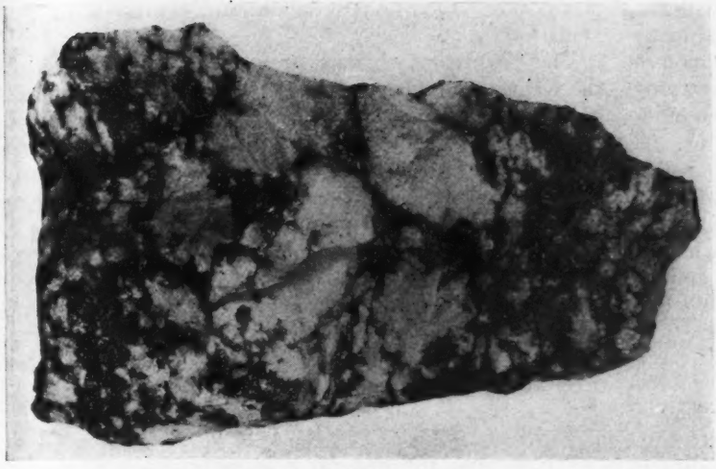


Fig. 2—Early barren quartz, brecciated and recemented by late sulphides, chiefly argentiferous tetrahedrite. Rising Star mine, Idaho. Natural size.

respective compositions of the two groups of satellitic intrusives. The mineralizing solutions, not appearing until after this stage, must manifestly be derived from one or both of these sub-magmas.

As a typical example we may consider the Mother Lode and Grass Valley regions of California. Following the intrusion of the granodiorite batholith of the Sierra Nevada, injections of acid satellitic dikes, pegmatites, aplites, and albitites occurred; and later injections of basic satellitic dikes, lamprophyres, and diabases, which cut the earlier acid group. The mineralization was still later, the veins cutting both groups of dikes. Faults and fissures along which the dikes were injected are positive evidence that at least the upper part of the batholith was solid before the mineralization occurred. The Mother Lode itself occupies a strong fault which locally cuts the granodiorite. The composition of the satellitic dikes is further proof that the batholith was largely solidified long before the mineralization occurred, for the materials of the dikes clearly represent differentiation products of the initial granodiorite magma. In the light of such evidence, the conclusion is warranted that the mineralizing solutions could not have been derived directly from the granodiorite magma during its crystallization, but must represent end products derived from the differentiation sub-magmas. Further examples representing the same sequence could, if necessary, be cited from all parts of the world.

Abundance of Basic Intrusives in Mineralized Areas

The possible relationship which may exist between hydrothermal veins and acid satellitic intrusives, as represented by pegmatites, aplites, and alaskites, has from time to time been considered by geologists. The possible relationship which the mineralization may have to the basic satellitic intrusives has not, however, received consideration—nor has the common presence of basic dikes in the vicinity of centers of mineralization attracted noticeable comment.

In an effort to determine just how frequently basic intrusives occur associated with ore deposits, I have made a somewhat hasty review of the literature, and find that both groups of intrusives, acid and basic, are almost universally present in the vicinity of centers of mineralization. One hundred and twenty of the more important mining camps of North America and 24 important camps in other parts of the world have been listed as containing basic intrusives. This list is vastly incomplete, since only the most easily accessible literature was consulted. In the cases listed there is manifest a *normal sequence* of (1) major intrusion, if present; (2) acid satellitic intrusions; (3) basic satellitic intrusions; and (4) mineralization. Of the 144 cases listed, 50 cases, or 35 per cent of the total, are definitely known to follow the normal sequence; in 57 cases (40 per cent) the sequence is imperfectly known, but in so far as known corresponds to the normal sequence; in 25 cases (17 per cent) the sequence is unknown; and in only 12 cases (8 per cent) is the sequence reversed. The trend of these figures is so pronounced that they must be recognized as indicating, not a chance phenomena, but a true expression of the various events which lead up to mineralization. Recognizing that mineralizing solutions must represent end products of differentiation derived from either the acid or basic sub-magmas of which the two groups of satellitic dikes are the indices, and recognizing that the latest pre-mineral igneous intrusions are in the vast majority of cases of a basic nature, a somewhat anomalous condition appears to exist. Which of the differentiation sub-magmas, acid or basic, is the more favorable source for the mineralizing solutions?

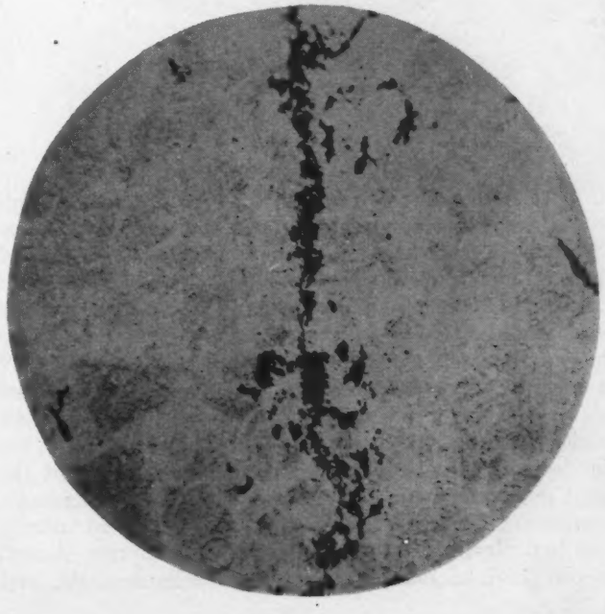
Before this question can be decided the attempt must be made to decipher the relative affinities of the several elements for the acid and basic differentiates respectively. We may tentatively recognize the following groups of these elements:

Group I. Tend to follow the acid differentiate: Si, Li, K, B, F, Ce, Yt, Sn, Th, Zi, Ta, Nb, W, Mo, Be, U.

Group II. Tend to follow the basic differentiate: (A) Certain: Ca, Mg, S, Cr, Co, Fe, Mn, Ni, Pt metals. (B) Probable: Cu, Ag, Zn, Pb, Hg, Au, As, Sb, Te, Se, Cl, P, Ba, Sr.

In Group I the elements are essentially those which

Fig. 3—Gold and galena (black) filling fractures in early barren quartz. Borders of fractures modified by replacement. Central Eureka mine, Mother Lode, California. Thin section × 20.



characterize extreme acid differentiates. Besides silicon, which as SiO_2 is the chief gangue of vein deposits, many of the other elements of this group are rather common in veins. To conceive that mineralizing solutions carrying any of these elements could have been derived from other than the acid differentiate seems unreasonable.

The elements of Group II-A are essentially those which characterize basic magmas. During the process of magmatic differentiation each of these elements tends to become concentrated in the basic rock phase, whereas the extreme acid differentiates, the pegmatites, aplites, and alaskites, are notably impoverished in these elements. Certain of the elements of this group, as Pt, Ni, Co, and Cr, are known to occur only in igneous rocks of basic composition. Yet all of these elements occur in vein deposits. Most of them occur commonly. Can we believe that these elements which are so characteristic of basic igneous rocks were derived from an acid differentiate?

The affinities of the elements of Group II-B, attributable largely to their sparse occurrence in nature, can be deciphered only with difficulty. Yet here again the apparent affinity appears to be for the basic differentiate.

Fig. 4—Sylvanite ($AgAuTe_4$), white, filling fractures in and replacing early barren quartz. 1,500 foot level, South Kalgurli Mine, Kalgoorlie, Western Australia. Polished surface. X13.

Copper is known to be rarely a constituent of acid igneous rocks, yet is always present in rocks of basic composition. Silver has been shown by means of rock analyses to have a preference for basic igneous rocks. The silver deposits of Cobalt appear to be related only to a series of basic intrusives—diabases. The quicksilver deposits of Almaden, in Spain, and of the California Coast Ranges are associated only with basic igneous rocks. Rock analyses show gold to be about as sparsely distributed in basic rocks as in rocks of intermediate to acid composition, but in deposits valuable for the contained gold content the gold is invariably most closely associated with minerals containing elements which show a pronounced affinity for basic magmas—that is, pyrite, arsenopyrite, chalcopyrite, and in many cases calcite, ankerite, talc, and mariposite. Occasionally platinum is present in gold veins.

The pegmatites show a pronounced concentration of the elements of Group I, but in them there is a notable lack of the elements of Group II. In contrast, those magmatic segregations which are valuable for their content of heavy metals are limited strictly in their occurrence to basic igneous rocks, and in them occur relatively pronounced concentrations of most of the elements of Group II. Gold is invariably present in such segregations in basic rocks.

To postulate that the elements of Group II were in general derived from acid differentiates would appear equally as unreasonable as to postulate that the elements of Group I were derived from basic differentiates.

Two Stages of Mineralization

Recognizing the general association of ore deposits with the two groups of satellitic dikes, acid and basic, which may be taken as indices of the presence of both acid and basic sub-magmas at a time immediately preceding the mineralization, and recognizing also, that, of the elements occurring in veins, certain ones suggest an origin from the acid differentiate, whereas other elements equally strongly suggest an origin from the basic differentiate, only one conclusion appears tenable—namely, that *hydrothermal and emanation types of ore deposits have resulted from the combined action of two sets of solutions: a solution derived from the acid differentiate and carrying predominantly the elements of Group I, and a solution derived from a related basic differentiate and carrying predominantly the elements of Group II.*

If this theory of ore genesis be true, we would expect to find, both in the field and in the microscopic study of ores, evidence of two stages of deposition. These stages might be distinct; they might overlap in part; or in some cases they might overlap completely. In general, however, we should expect to find evidence of an earlier stage characterized chiefly by siliceous gangue, with a minimum of basic (metallic and associated) minerals, and of a later stage characterized by a relative preponderance of metallic minerals with a relative subordination of the gangue minerals of the earlier period.

That the metallic minerals of hydrothermal veins are usually deposited during the latter part of the period of mineralization—the early deposited material consisting largely of barren quartz—has long been recognized by geologists. Abundant and varied evidence could, if space permitted, be offered to show how universal in ore deposition is this commonplace sequence. The following statement, made by the late Professor James Furman Kemp, will suffice:[1]

"In quartz veins productive of gold, with associated sulphides, chalcopyrite, arsenopyrite, pyrite, galena, zinc blende, and perhaps some rarer sulphides, often the quartz vein has obviously been first formed and then shattered. The sulphides and the native gold have come into the little cracks and fissures and now appear with irregular, triangular cross-sections in the specimen. Clearly in their precipitation, they have followed systems of cracks.

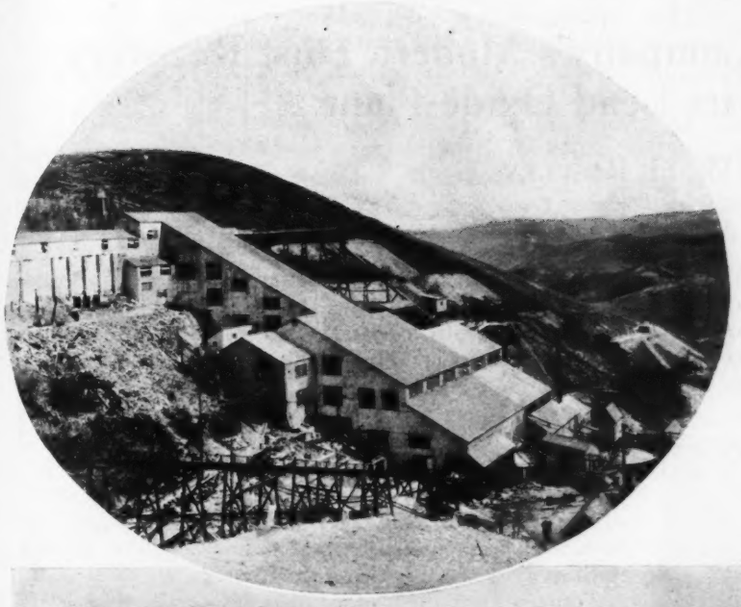
"The filling of such a vein and its values must then be assigned to two periods, one of solid quartz without much value in it; and afterwards, one of enrichment by the circulation of solutions that brought the metallic minerals into the cracks and deposited them."

(To be continued)

[1]J. F. Kemp: In discussion of "Magmas, Dikes and Veins," by W. Lindgren. *Trans.* A.I.M.E. Vol. 74, p. 95, 1926.

MILL TONNAGE INCREASE

Secured by Remodeling Not Duplicating Existing Units



IN THE oval is the building housing the mill of the Silver King Coalition Mines Company, near Park City, Utah, the capacity of which was recently increased from 600 to 1,000 tons per day, by remodeling and equipment substitution, instead of enlarging. Below is a portion of the surface plant of the Silver King Coalition property. Across the road from the mill at the right is the assay office, and just beyond it along the road is the superintendent's residence. The inclined tramway from the mill leads to the sampler. On the hill behind the mill is a section of the rope tramway that conveys concentrates and high-grade ore to Park City, and coal from Park City to the property. The two white buildings behind the terminal of the rope tramway are company bunk houses. At the extreme left is the company office and boarding house. Ore cars are moved by electric-trolley locomotives from the main shaft to the crushing department of the mill through the covered haulageway running across the middle portion of the view.

Solving a Fume Problem

Evans-Wallower Lead Company's Modern Dust Recovery System in Its Lead Oxide Plant

By W. H. ROWLEY

Vice-President, Evans-Wallower Lead Company, Charleston, W. Va.

BEFORE my connection with the Evans-Wallower Lead Company, I had a varied experience covering many years' operation of white lead, lead oxide, and lead-smelting plants, wherein the old-fashioned baghouse was generally utilized to collect lead dust and fume.

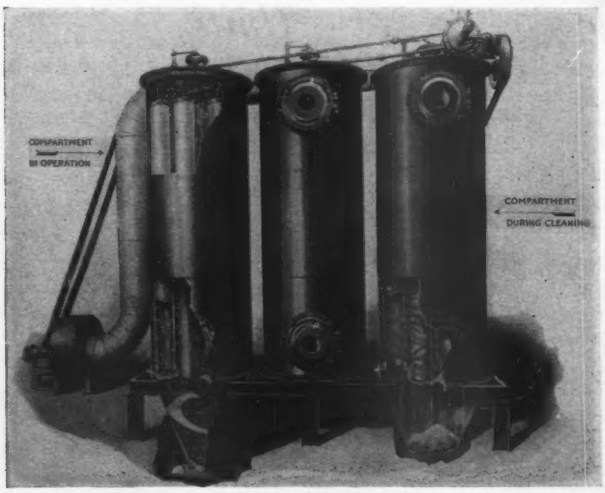


Fig. 1—Partial sections of filters during operation and cleaning

We had become pretty well hardened to the idea that this equipment was a necessary evil and that the workmen must make the best of it. When planning our construction at Charleston six years ago, however, we determined to try something different, and better, if possible. Especially were we anxious for early completion of the job, as we had many orders on our books and postponement of delivery would have been costly. To build the ordinary baghouse, of course, requires some time.

After a hurried survey of the situation the management decided to make a trial of automatic self-cleaning filter machines, though the equipment we had in mind had, at that time, been on the market for only a short time, and had been used principally for dust collecting in the chemical field, with only a few small installations in various types of smelting plants. The results have exceeded our expectations. Not only has the system proved an efficient fume- and dust-collecting device, but it saved us money in installation cost and operation cost as well, and has eliminated a great deal of waste, labor turnover, sickness, and other grief in our plant.

The first of these filtering machines was put into operation on our lead-fuming furnaces. The installation consisted of two fuming furnaces of local design, each equipped with U-tube coolers, which were, in turn, connected with one ten-compartment and one eight-compartment filter. These latter were of the so-called Perfecto type, built by the Dust Recovering & Conveying Company, of Cleveland, Ohio. The total of eighteen filter compartments provided a total filter area of approximately 3,300 sq.ft. This gave a capacity of 16,000 cu.ft. of gas per minute after the gas had been cooled through the coolers to about 200 deg. F., equal to $4\frac{3}{4}$ cu.ft. of gas per minute per square foot of filter surface. This is approximately nine times the volume of gas handled per unit of filter surface in the ordinary old-fashioned baghouse practice. A much more efficient utilization of space is therefore secured.

To make clear the manner of operation of these filters, reference should be made to the accompanying Fig. 1, which is a sectional view, supplied by the manufacturers, of a three-compartment unit. As will be observed, the filters are under suction maintained by the fan at the left, so that for any dust to escape into the room in which they are housed is physically impossible. The filter cloth used is of dense weave, so that with the gas and air volumes used at this plant, almost perfect collecting efficiency is secured.

The success of the first installation suggested the application of a complete Dracco system for the grinding, screening, and packing operations, which is now completed; this includes filters, air suction lines, hoods, and accessory equipment in connection with the mills, screens, mechanical conveyors, elevators, and packers about the plant. The unit capacity of this later equipment is essentially the same as in the first installation; 8,000 cu.ft. of air per minute is drawn through a six-

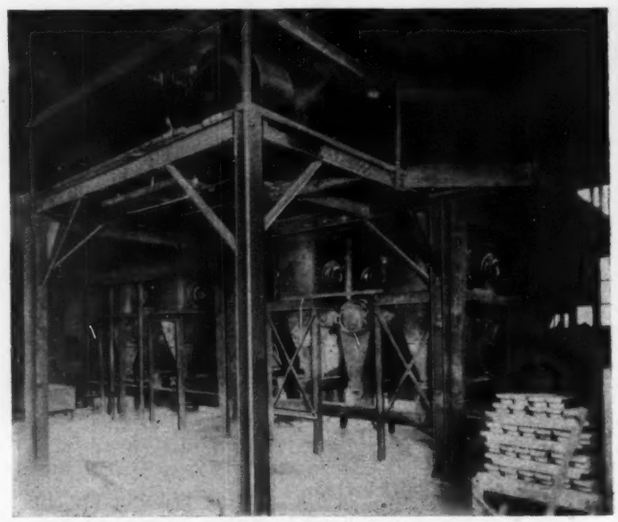


Fig. 2—Installation of fans and filters at Charleston plant, with mechanical conveying equipment

compartment and a four-compartment filter. Also, a duplicate installation of the first fuming plant has been constructed, consisting of two fuming furnaces, a U-tube cooler, and two ten-compartment filters. The capacity of this fume equipment is similar to that of the original installation—16,000 cu.ft. of gas per minute. Litharge fume that is filtered out is automatically discharged from the filters as well as from the coolers, to a mechanical conveying system which transports it to the central packing and shipping department. The conveyors can be seen under the filters in Fig. 2. The only further step that can be suggested in the modernization of the plant is the use of a pneumatic conveying system instead of mechanical conveyors, which would put everything under suction and make all operations dust-free.

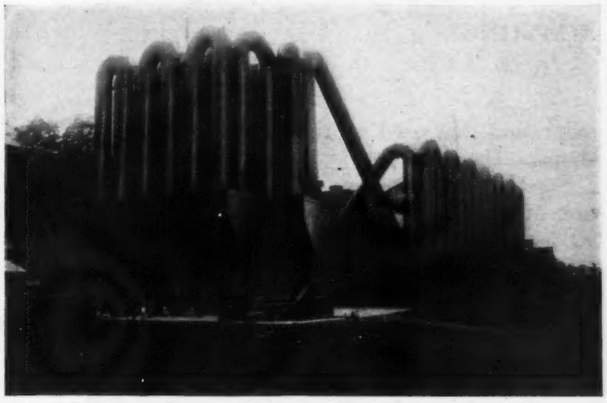


Fig. 3—Coolers, with automatic cleaning equipment

U-tube coolers, shown in Fig. 3, are considered a distinct improvement in that they have an automatic cleaning device, consisting essentially of specially designed scrapers. No knocking by hand is necessary, and the usual denting and spoiling of tubes, with the resultant decrease in efficiency and reduction of high radiation, has been eliminated. Furthermore, the tubes are clean.

A similar system of fume recovery has been installed in connection with the mechanical furnaces where various kinds of red lead and litharge are made. The fume is reclaimed with practically no loss, instead of allowing it to escape to the open air through stacks, and into the furnace room when taking the charge out of the furnace. Two eight-compartment filters are used in this service, and space has been provided for four additional compartments for further expansion. There are three hoods on the furnaces and one connection on the stack leading to the flue which carries the dust to the filters.

Altogether, 64 filter compartments have been installed in our plant, and they have been working most efficiently. At no time have we had to shut down a furnace or any other of our machinery on account of something going wrong with the filters. Should any mishap occur in one compartment—that is, if a filter bag should break—it can be cut out of the circuit without interfering with the rest of the filter unit. Only one man is required to look after all of our filter installations. The flexibility of the installation is manifest.

Operating cost, compared with that of the ordinary baghouse, is considerably less, as the life of the bags in the filters, depending a great deal on how well temperatures are controlled, is from one year to several years, and there are no parts of the filters to get out of order that cannot readily be repaired at small cost.

The Copper Industry in 1928

THE outstanding feature of the copper industry in 1928, according to the U. S. Bureau of Mines, was the heavy domestic demand during the latter part of the year, which caused domestic withdrawals for the year to be the highest recorded with the exception of 1918. The price of copper increased throughout the year. Demand, followed by the highest prices that had been paid since April, 1923, brought forth a response from the mines in the form of largely increased production. Smelter production from domestic ores increased about 10 per cent during the year, and that this increase is largely owing to heavy production in the latter part of 1928 is shown by the estimate of smelter production in December, 89,500 tons, which is 13,500 tons higher than the monthly average for the eleven months preceding. As from two to three months' time is required for copper in ore mined to appear as refined copper, the increased mine production had not up to the end of the year caused as large an increase in refinery output as it had in smelter output. Increased mine production was not made soon enough to save the producers from drawing largely on their stocks of refined copper to satisfy consumption, and refined stocks have been depleted during the year from 85,500 tons to estimated stocks of 47,500 tons on Dec. 31. The drop in imports of refined copper and the increase in exports caused a further depletion of refined stocks. Blister stocks also were decreased in 1928.

Imports of unmanufactured copper during 1928, according to the Bureau of Foreign and Domestic Commerce, amounted to 393,427 tons, a monthly rate of 32,785 tons, compared with 354,161 tons for 1927, a monthly rate of 29,513 tons. Total imports for 1928 thus showed an increase in quantity of approximately 40,000 tons.

Exports of metallic copper during 1928 amounted to 560,155 tons, compared with 534,747 tons exported in 1927, an increase of about 25,000 tons, or close to 5 per cent, compared to the preceding year. In 1928, 474,154 tons of refined copper in ingots, bars, or other forms was exported. Of this quantity Germany received 103,275 tons, the highest amount, though her takings fell off materially toward the end of the year owing to a dislocation of industrial conditions. The United Kingdom was next with 92,908 tons, France was third with 85,721 tons, and Italy took fourth rank among European consumers with 57,714 tons for the year. In 1927, Germany received the largest amount as well, 110,921 tons. The United Kingdom was next with 91,283 tons, France was third with 55,979 tons, and the Netherlands occupied fourth place with 52,300 tons. Germany's takings in 1928 were thus somewhat less than in 1927, and Holland's requirements fell off markedly. The United Kingdom was about the same, but France and Italy increased 53 and 34 per cent respectively.

Estimates place stocks of blister copper at the smelters, in transit to refineries, and at refineries, and materials in process of refining, at about 189,000 tons on Dec. 31, compared with 200,500 tons at the end of 1927, a decrease of 11,500 tons. Therefore, a decrease of 49,500 tons in total smelter and refinery stocks is indicated.

The quantity of new refined copper withdrawn on domestic account during 1928 was about 794,000 tons, compared with 711,500 tons in 1927, an increase of 82,500 tons, or approximately 12 per cent. Domestic withdrawals in 1928 were the highest ever recorded with the exception of those in 1918.

MINING MAGNETITE *in the New York Mineville District**

CONCLUDING INSTALLMENT

By A. M. CUMMINGS
Consulting Engineer, U. S. Bureau of Mines

In Part I, published in the issue of Feb. 2, Mr. Cummings discussed the geology of the Mineville district and the ore deposits; also the methods of exploration, development and stoping. Further details of the underground operations, with pertinent data as to wage scales and unit costs are given in the following:

Drilling and Blasting Practice

THE air compressors range in capacity from 300 to 5,600 cu.ft. per minute. All except the 300-cu.ft. machines are located on the surface in central plants. The 300-cu.ft. machines are underground and are used when a small amount of air is required for work between shifts.

Nearly all makes of drills are in use in the Mineville district. With few exceptions, they are operated as one-man machines. The heavier drills are used in the main shafts and main haulage roads and are operated on tripods, columns, and bars. They are equipped to use 1¼-in. round, hollow drill steel.

The light drills are used in all the auxiliary shafts, stoping levels, and small drifts and are equipped to operate dry or with water as occasion demands. They are operated on columns, tripods, and by hand. A cradle is used to hold the machine in the shell and is so designed as to allow it to operate with the hose connection on the outside, away from the face, which permits them to be run near the side wall, thereby making it possible to leave a good burden on the top of the hole. These machines are equipped for the use of ⅞-in. hexagon, hollow drill steel.

Both the 1¼-in. steel and ⅞-in. steel are made up with cross bits, and have a 14-deg. taper and a ¼-in. difference in gage. Four changes of steel are used and holes up to 10 ft. in depth are drilled. The holes are started at 2¼-in. gage with the 1¼-in. steel and bottomed at 1½-in. gage. With the ⅞-in. steel, the holes are started at 2-in. gage and bottomed at 1¼-in. gage. The shanks used are of the standard lug type. These steels are bitted and shanked on sharpening machines located underground on the main haulage levels.

No meter records are available giving the air consumption per ton for drilling. The air-compressor account includes the air used for operating pockets and chute doors, air hoists, pumping, and complementary equipment, and that used on the surface above the mills and shops. The total cost is 10c. per ton of ore hoisted.

Steel consumption in 1927 was 0.125 lb. per ton of ore, of which 10 per cent was 1¼-in. round hollow and 90 per cent ⅞-in. hexagon hollow.

LOADING AND TRAMMING

Tramming in the auxiliary shafts is effected by hand-pushed tram cars having a capacity of 1½ tons of ore and by haulage cars with a capacity of 3½ tons of ore. The latter are drawn by electric locomotives of the trolley type.

The hand tram car, which is very low (2 ft. 7 in. above rails), is used when the loading is done by hand. Haulage cars are high (4 ft. 5 in. above the rails), and are loaded by power shovels or with scrapers.

The mechanical loading is a problem on which much time and money have been spent. This problem has by no means been completely solved, but the conclusion thus far reached is that a combination of the scraper and small air-operated shovels is best suited to these deposits. In arriving at this conclusion, factors other than the actual loading of the material have been taken into consideration, such as the effect on cost of stoping, the amount of money tied up in development work, and the crude content and faulted condition of the deposit.

A scraper hoist of the clutch type with planetary transmission, operated by 25-hp. d.c. motor, has proved the most satisfactory hoist to date. Direct current as applied in haulage locomotive motors is found to be more efficient for this kind of load than the alternating current. If the voltage on the scraper hoist motor is made the same as the voltage on the haulage locomotive motor, no extra line will be required. The scraper motor can be operated by simply connecting it to the rail and trolley wire. Inasmuch as most scrapers are served by a haulage locomotive, this is very important. Scrapers of the hoe type are employed exclusively.

Air-driven shovels of the dipper type have proved more satisfactory in this work than the electrically driven machines. They have a lower first cost, smaller upkeep, will handle an equal amount of material per shift, and are easy to transfer from one working place to another. The air consumption with the air-driven shovel is high, giving a higher power cost per ton loaded. When it is considered, however, that the shovel is operated in unventilated places and often directly after blasting in a

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drift, the benefit of the exhaust air for ventilation may offset the lower power consumption of the electrically operated type.

As compared with scrapers, the shovels have a higher first cost and higher power consumption. They have the

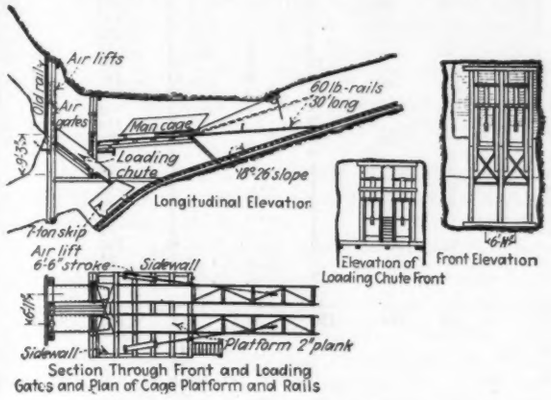


Fig. 8—Pocket, gates, and cage platform

BILL OF MATERIAL

4 air gates, with guides.
4 air lifts, 4 ft. lift.
2 air lifts, 6 ft. 6 in. lift.
2 loading chutes, 3 ft. high.
2 lip chutes.
4 8-in. sheaves.
2 throw rails.
65 ft. ½-in. or ⅝-in. wire rope.
36 old rails—pocket front.
8 hangers, for air lifts.
6x6-in., 8x8-in., 10x10-in. timber plank for platforms.

advantages, however, of working better in a drift and of being suitable to replace hand loading in most places on the levels without changing the mining method. Total loading cost is about the same with the shovels as with the scrapers, and in either case is dependent on the quantity of broken material available. No increase in the stoping cost is involved.

The electrically driven shovel shown in Fig. 6 will operate in a space 15 ft. wide and has proved to be the most satisfactory loading device where the orebody over a considerable area is large enough to give it operating room. Fig. 8 gives the details of a typical ore chute and door arrangement at a pocket on the main shaft. Fig. 9 shows the door and chute at the pocket on the main haulage road. The electric locomotives in use are all of the trolley type and range from 1,200 to 3,000 lb. drawbar pull. The large size is used on the main haulage roads and the smaller size on the levels and drifts from the auxiliary shafts. Table I gives the haulage costs per ton-mile on one of the main haulage roads for a period of one month. Distances are from main shaft pocket to auxiliary shaft pocket. Tonnage, distance, and labor costs are taken from the actual records. Power and supplies are prorated from the total haulage account. The number of auxiliary shafts makes necessary the use of many hoists underground. They are all electrically operated, but are of several different makes and range from

Table I—Electric Trolley Locomotive Haulage Cost for One Month

Tons Handled	Length of Haul		
7,591	750 ft.	Total ton miles	3,080
9,715	800 ft.	Total cost	$427.00
8,682	1,550 ft.	Cost per ton mile	$0.084
Total....25,988	Average 1,032 ft.		

600 hp. with 1,200 ft. per minute roped speed, down to the hoist driven by a 22-hp. motor and having 400 ft. per minute rope speed.

The mines are comparatively dry, as most of the water comes from the surface. Water is prevented from reaching the lower parts of the mine by being collected in sumps, from which it is removal by electric pumps having capacities varying from 100 to 400 g.p.m. Small air pumps are used in the sinks to take care of the seepage.

The record of the tons per drill, tons per man, tons per man tramming, tons mined, and related data at the Harmony and Old Bed mines combined, for the year 1927, is given in Table II:

Table II—Record of Labor Performed at the Old Bed and Harmony Mines, 1927*

Mining:	Total Shifts for Year	Tons per Shift
Trammers	35,306	.
Runners and helpers	16,866	.....
Miscellaneous	34,144	.....
Total underground operations	86,316	8.03
Total drill shifts	16,873	41.06
Development:		
Trammers	4,047	.....
Runners	2,459	.....
Drill shifts	2,226	.....
Total underground labor	92,822	7.46
Total drill shifts	19,099	36.27
Total trammers	39,353	17.60

* Ore hoisted at Old Bed and Harmony mines during 1927 amounted to 692,726 tons.

Table III shows a copy of one of the mine daily reports of underground operations for Dec. 31, 1927, and the results for the month of December, and the entire year 1927.

At the Witherbee, Sherman & Company's mines the wage is based on an hourly rate. For 1927 the schedule

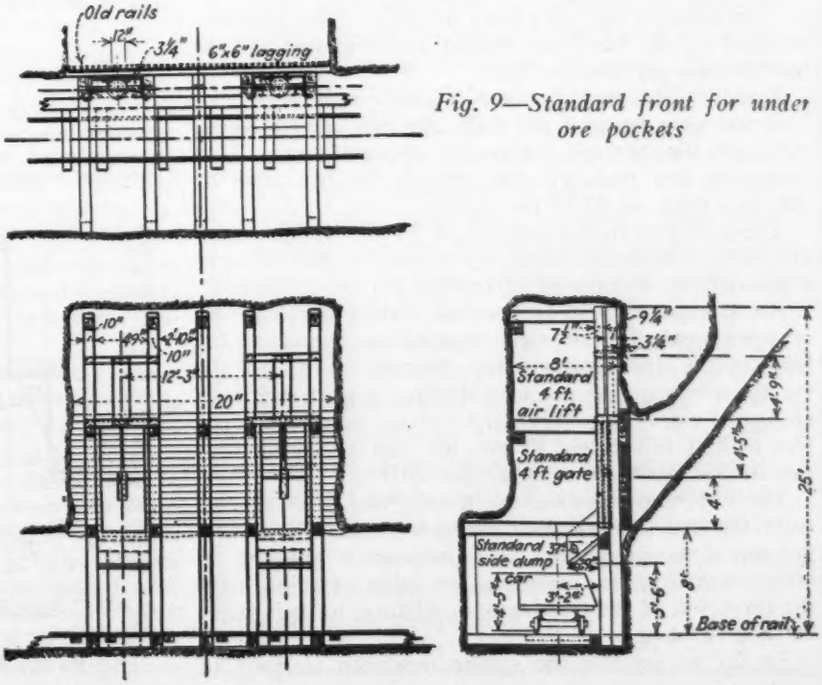


Fig. 9—Standard front for under ore pockets

Table III—Specimen Daily Report of Underground Operations

Location	General	Levels	Slope Sink	No. 1 No. 5 Levels	No. 4 Levels	No. 5 Levels	No. 6 Levels	No. 8 Levels	No. 8 Sink	No. 9 Levels	No. 9 Sink	No. 2 Operating	No. 2 Total	Total Day Operating	Total Day Development	Total Day Total	Total Month Operating	Total Month Development	Total Month Total
General foreman	1	..	..	....	....	....	....	....	...	...	...	..	...	1	...	1	26	.....	26
Shift bosses	1	..	..	....	....	....	....	....	...	...	...	..	...	1	...	1	26	.....	26
Slope bosses	...	1	..	1	1	....	1	1	...	1	...	1	26	6	...	6	178	.....	178
Assistant slope bosses	...	..	..	1	1	....	1	1	...	1	...	..	...	5	...	5	141	.....	141
Bell ringers	...	..	..	1	2	2	1	2	...	1	...	..	...	9	...	9	228	.....	228
Leyner machines	...	..	2	....	....	....	....	2	...	...	...	..	...	2	2	4	57	136	193
Jack hammer machines	...	..	..	2	8	2	4	6	1	5	1	..	...	27	2	29	724	40	764
Machine men	...	..	2	2	8	2	4	8	1	5	1	..	...	29	4	33	781	176	957
Contract trammers	...	..	..	4	15	6	10	16	...	6	2	..	...	57	2	59	1,514	256	1,770
Day trammers	...	..	..	2	....	....	....	....	...	1	...	..	...	3	...	3	83	4	87
Shovel	...	..	..	....	2	....	....	5	...	...	...	..	...	7	...	7	234	3	237
Brakemen	2	1	..	2	1	1	1	1	...	2	...	1	26	11	...	11	295	.....	295
Repair and pump men	6	..	..	....	....	....	....	2	...	...	...	..	...	8	..	8	118	.....	118
Blasters	1	..	..	....	....	....	....	....	...	...	...	..	...	1	...	1	26	.....	26
Trainmen	2	..	..	....	....	....	....	1	...	...	...	..	...	3	...	3	91	.....	91
Drill shop	2	..	..	....	....	....	....	....	...	...	...	..	...	2	...	2	52	.....	52
Electricians	2	..	..	....	....	....	....	....	...	...	...	..	...	2	...	2	61	.....	61
Pocket men	2	..	..	....	....	....	....	....	...	...	...	..	5	2	...	2	52	.....	52
Carpenters	9	..	..	....	....	....	....	....	...	...	...	12	167	9	...	9	246	.....	246
Roof men	1	..	..	....	....	....	....	....	...	...	...	..	...	1	...	1	22	.....	22
Rope men and oiler	1	..	..	....	....	....	....	....	...	...	...	..	...	1	...	1	26	.....	26
Cage men	...	..	..	....	....	....	....	....	...	...	...	..	...	...	...	....	.....	.....	.....
Total men underground	30	2	2	13	30	11	18	37	1	17	3	14	224	158	6	164	4,200	439	4,639
No. cars (hand)	...	..	..	64	212	108	160	302	...	95	...	..	...	...	...	941	.....	.....	25,129
No. cars (trolley)	...	..	..	....	....	....	....	19	...	....	....	..	...	...	...	19	.....	.....	199
No. cars (contract)	...	..	..	64	248	120	172	302	...	90	48	..	...	...	...	1,044	.....	.....	33,534
No. cars (trolley) shovel	...	..	..	....	15	....	....	20	...	....	....	..	...	...	...	35	.....	.....	917
No. skips hoisted (sink)	...	..	..	....	....	....	....	....	...	....	22	..	...	...	...	22	.....	.....	2,392
Tons by U. G. cars	...	..	..	64	257	108	160	362	...	95	44		...	...	.....	1,090	.....	.....	32,664
Tons per trammer	...	..	..	10.6	15.1	18.0	16.0	17.2	...	13.5	22.0	..	...	...	...	22.12	.....	.....	16.78
Tons per machine man	...	..	..	32.0	32.1	54.0	40.0	45.2	...	19.0	44.0	..	...	...	...	46.24	.....	.....	36.71
Tons per man	...	..	..	4.92	8.56	9.72	8.89	9.78	...	5.58	14.6	..	...	...	...	9.30	.....	.....	7.47
Holes fired	...	..	24	10	52	16	27	64	10	40	10	..	...	209	44	253	6,400	1,758	8,158
Powder used (sticks)	...	..	300	80	420	150	250	550	100	300	100	..	...	1,750	500	2,250	55,530	21,420	76,950
No. skips hoisted (levels)	...	..	..	44	110	72	106	142	...	50	...	..	...	...	...	524	.....	.....	13,922
No. trolley cars (haulage)	..	..	..	....	....	22	22	....	...	...	...	..	...	...	...	44	.....	.....	3,389
Main haulage skips	155	..	..	....	....	....	....	....	...	...	...	..	...	...	...	155	.....	.....	4,334
Surface skips	300	..	..	....	....	....	....	....	...	...	...	..	...	...	...	300	.....	.....	8,856
Tons by surface skips	975	..	..	....	....	....	....	....	...	...	...	..	...	...	...	975	.....	.....	28,784
Actual tons	...	..	..	....	....	....	....	....	....	...	...	..	...	...	...	1,526	.....	.....	35,139
Analysis	...	..	..	....	....	....	....	....	...	...	...	..	...	...	...	....	.....	.....	.....
Ratio	...	..	..	....	....	....	....	....	...	...	...	..	...	...	...	1.32	.....	.....	1.30
Tons per hand tram car	...	..	..	....	....	....	....	....	...	...	...	..	...	...	...	1.40	.....	.....	1.07

Remarks: Hoisting 8:00 a. m. to 3:45 p.m.

December 31, 1927

as applied to the important classifications was as given in Table IV.

Table IV—Schedule of Base Wage Rates, Witherbee, Sherman & Company

	Rate per Hour
Trammers	$0.32
Drill runners	.36
Hoist men and locomotive operators	.34
Carpenters and repair men	.40
Foreman and roof man	.41
Shift foreman	.45

A premium is paid all classes of labor. This premium is based on the hand cars loaded and trammed and the tons broken per man drilling.

Twenty-eight cents per car is paid to the men who load and tram ten cars per shift, 29c. per car for eleven cars and 30c. per car for twelve cars and over. Men tramming less than ten cars receive the base rate of 32c. per hour, or $2.56 per shift.

The tram cars have a capacity of 1½ tons of the richest ore when completely filled, but owing to the different grades of ore, an average of one ton per car is obtained.

An average of 30 tons per man drilling for a period of one month for all men engaged in drilling is the basis of the drilling premium. Fourteen cents per ton for the average tons per man drilling is paid each man engaged in drilling. When the average of the tons per man drilling falls below 30 tons, the men receive the base rate of 36c. per hour, or $2.88 per shift.

The difference between the hourly rate of $2.88 per shift for drill runners and the amount earned at 14c. per ton is the premium. This premium is given to all other classifications, including the mine captains, with the exception of the trammers, in addition to their regular hourly rates.

As far as possible the system described is made to apply to all conditions, but there are exceptions in both tramming and drilling work which make adjustments necessary in order that compensation for the work may be more comparable to the rate for average conditions.

In some of the sinks and long headings, special arrangements are made as to the number of cars required for a day's work. To make their earnings per shift higher, extra hours are given the drill runners when in difficult places requiring the most experienced men. Extra hours are also given to those who assist in blast-

Fig. 10—Operating data for Old Bed and Harmony mines combined

Legend: Full lines with circles, tons per man per day underground; broken lines with circles, average daily wages underground; upper heavy lines, tons crude ore mined; lower heavy lines, cost of production.

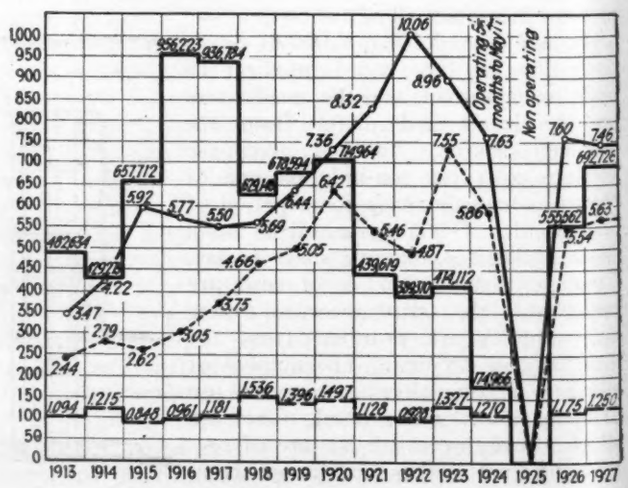


Table V—Mining Cost of Delivering a Ton of Ore to the Surface[1]

	Labor Underground	Supervision Labor	Compressors, Air Drills, Drill Steel	Electric Power	Explosives(a)	Other Supplies	Total
Development	.061	.005	.015	....	.021	.001	.103
Stoping	.164	.014	.113	....	.122	.003	.416
Tramming	.333	.027	....	.005	....	.038	.403
Haulage	.028	.002	.015	.008	....	.012	.065
Hoisting	.105	.009	....	.070	....	.053	.237
Pumping	.007	.000	.012	.004	....	.003	.026
Total	.698	.057	.155	.087	.143	.110	1.250

(1) Ore hoisted at the Old Bed and Harmony mines during 1927 amounted to 692,726 tons.
(a) Includes caps and fuse.

ing. The hoist man and electric locomotive operators receive extra hours when the hoisting extends beyond the regular eight-hour shift.

The average wage for all men at Harmony and Old Bed mines for the year 1927 was $5.63 per day.

Fig. 10 is a chart showing the tonnage, costs, tons per man, and wages from 1913 to 1927, inclusive. To one with a knowledge of conditions existing at the time, the effect of tonnage and labor conditions on costs and efficiency is plainly shown by this chart for the different years. The factors affecting costs are the character of the orebody, tonnage requirements, cost of labor and supplies, and the amount of money available for equipment and exploration.

Table V gives the mining cost of delivering a ton of ore at the shaft houses on the surface at Witherbee, Sherman & Company's Old Bed and Harmony mines combined, during 1927. This is the total underground cost with the exception of 6c. per ton charged to a deferred account which includes equipment for main shaft extension.

Table VI—Summary of Costs in Units of Labor, Power, and Supplies

Name or number of mine, Old Bed and Harmony.
Year, 1927.
Tons ore mined and hoisted, 692,726.
Mining method, open stopes with pillar support.

	Development	Mining	Total
A. Labor (man hours per ton)			
Breaking (drilling and blasting)	$0.028	$0.236	$0.264
Timbering	.....	.....	.....
Mucking	.046	.480	.526
Haulage and hoisting	.....	.193	.193
General	.....	.....	.....
Pumping	.....	.010	.010
Supervision	.006	.074	.080
Total labor underground	.080	.993	1.073
Average tons per man per shift	.....	.....	7.46
Labor, percentage of total cost	5.28	55.12	60.40
B. Power and supplies			
Explosives (pounds per ton)	$0.138	$0.799	$0.937
Total power (in kilowatt-hours per ton)	.....	.....	10.91
(1) Air compression	.....	.....	5.16
(2) Hoisting	.....	.....	4.64
(3) Pumping	.....	.....	0.26
(4) Ventilation	.....	.....	.....
(5) Lighting	.....	.....	.....
(6) Haulage	.....	.....	0.52
(7) Tramming	.....	.....	0.33
Other supplies in percentage of Total supplies and power	.20	22.02	22.22
Supplies, percentage of total cost	2.96	36.64	39.60
C. Percentage of total cost	8.24	91.76	100.00

What Conditions Are Favorable to Use of Caving Method?

BODIES of copper ore suitable for mining by a caving method are generally of the disseminated type, according to the U. S. Bureau of Mines. A rock structure that allows ready access of the mineral-bearing solutions is generally a favorable factor for mining the ore mass by a caving system. The ore mass should contain sufficient fractures or be of a texture so that the rock will break in relatively small fragments in caving. Large, hard blocks of ore increase the cost of mining by a caving method and may make this system uneconomical in some cases.

The mineral constituents are also an important factor to be considered in mining of an orebody by a caving method. Minerals that cause the ground to swell on exposure to air or moisture, or minerals that cause the broken ore to stick in chutes or drawing raises, are particularly undesirable in mining by a caving system. An excessive amount of such minerals as kaolin or talc in an orebody may make inadvisable the selection of a caving method of mining. Only well-drained orebodies should be mined by a caving system, as excessive moisture increases the cost.

In mining by a caving method the last of the ore in a block may not be drawn until a year or more after it is broken; therefore, the orebody should not contain minerals that will oxidize, or promote oxidation of the valuable minerals if the ore mined is to be treated in concentrators. For instance, pyrite oxidizes rather readily and on oxidizing produces sulphuric acid and ferric sulphate, which attacks chalcocite and bornite. At an Arizona copper mine a block of ore that had been undercut and caved was allowed to stand for about a year. On drawing later, it was found that part of the copper was in the acid-solution form, which caused difficulties in the concentrator and increased the losses in the tailing. This particular block had a relatively large amount of pyrite associated with the copper sulphide minerals.

Developing Copper Mines for the Next Generation

IN Canada and in central Africa, reserves of copper ore are now being disclosed that seem destined to furnish an increasingly important part of the world's copper production in the years to come. In London, Mr. George L. Walker recently interviewed Mr. A. G. McGregor, who was responsible for the design of many of the important metallurgical plants in the Southwest; who has more recently been consultant for the International Nickel Company in its new smelter construction at Copper Cliff, Ont.; and who is now consulting engineer in charge of the construction of metallurgical plants for several of the Rhodesian copper companies. With this background of experience, Mr. McGregor's comments on recent developments, both in Canada and in Africa, possess unique authority and will undoubtedly be of interest to students of the copper situation and of copper metallurgy. They will appear in an early issue.

Bentonite—A Mineral of Many Possibilities

ONE of the oddest and least known mineral substances is bentonite, according to the U. S. Bureau of Mines. Certain bentonites have such a strong affinity for water that they are capable of absorbing more than ten times their volumes of water. Because of its peculiar physical properties bentonite has been suggested as a component material in manufacturing commodities as diversified as paper, rubber, putty, phonograph records, pencil leads, and soaps. On the other hand, underground deposits of bentonite have caused great difficulties in drilling oil wells, it frequently becoming necessary to take special steps to combat them as a nuisance.

The properties, mining, preparation, and utilization of bentonite have formed the subject of an investigation recently conducted under a co-operative agreement between the Bureau of Mines and the Mackay School of Mines, University of Nevada. Samples of bentonite from many sections of the United States were studied in the course of this investigation.

Bentonite contains 75 per cent or more of the crystalline claylike minerals montmorillonite or beidellite, according to C. W. Davis, associate chemist, Bureau of Mines, and H. C. Vacher, graduate research fellow, University of Nevada, in Technical Paper 438, recently published.

Investigators have long recognized the occurrence of a peculiar claylike substance which, when wet with water, resembled soft soap and was called "mineral soap" or "soap clay." Early reports show that such material had been used long ago at the Hudson Bay posts in Canada for washing blankets.

Shipments for commercial purposes were first made in 1888 by William Taylor, of Rock Creek, Wyo., after whom the material was called "taylorite." In 1898, however, it was learned that "taylorite" had already been used to designate potassium ammonium sulphate. This substance was therefore called bentonite, because of its occurrence in the Fort Benton formation of the Rock Creek district.

At the time considerable interest in the mineral was aroused, but it soon subsided, and the price of $25 per ton fell to $5 per ton. In the last few years, interest in bentonite has revived, resulting in investigations that have developed industrial processes and products in which bentonite apparently has an important part. The prices today at Western points for finely pulverized material approach $25 a ton.

Of the many uses suggested, only a few have been tested, and investigators have not worked out the properties of bentonite that determine its usefulness, nor have tests been made to determine what type of bentonite is best suited to the different uses.

Bentonite deposits occur in beds from a few inches to many feet thick, mainly in the Tertiary but to some extent in the Paleozoic and Mesozoic rocks in many parts of the United States and Canada. Deposits have also been reported from Mexico, China, and France. Most bentonite deposits are the result of devitrification and partial decomposition of glassy volcanic ash.

Bentonite outcrops are unique and striking. As little vegetation will grow on them, they are barren, and because of the peculiar physical properties of the mineral they often present a crinkled coral-like appearance. If the internal portion of bentonite at an outcrop is dry, it finally absorbs water and swells greatly, producing cracks in the surface layer, which has meanwhile become more or less dry. After a rain many bentonite outcrops are covered with a thick mass of slippery jelly, but in dry weather the surface may be dry and fluffy or may have a peculiar granular appearance.

Wyoming bentonite is usually considered a standard type in studying other so-called bentonites. One of the important producers of the material has deposits at Medicine Bow and a grinding plant at Cheyenne. Another important producer in Wyoming has a mine at Clay Spur, near Newcastle. A large new deposit of bentonite has recently been reported in Johnson County. What is possibly an extension of the Wyoming bentonite deposits occurs near Belle Fourche, S. D. On claims owned by one company at this place, estimates place millions of tons of high-grade bentonite.

The largest known California bentonite deposits occur in the arid desert region along the Amargosa River in Inyo County. Deposits have also been found in Nevada, New Mexico, Idaho, Tennessee, Kentucky, and Alabama.

Nearly all bentonite deposits contain gritty or sandy inclusions, which are considered impurities and must be removed before marketing. Pulverized bentonite is fine grained and commonly light colored, ranging from cream to olive green; but it may be pink, dark brown, or even black, the color usually, but not always, becoming darker on wetting. When fired it is white, buff, or brown. Fresh material when cut usually has a waxy luster, which may become dull or powdery on drying. Some varieties may be cut into thin shavings.

Prospectors or others who become interested in bentonite production should make a careful investigation of the commercial possibilities of the deposit in question before investing heavily. Such a study should include the possibility of marketing the product, the specifications demanded, the price obtainable, the cost of mining, treating, and shipping to market, the size of the deposit, and the nature of the crude bentonite. Most consumers desire a homogeneous product that will remain uniform over a period of years. Deposits containing bentonite of this quality are not common. Most crude bentonite contains appreciable quantities of objectionable impurities such as sand, gypsum, carbonaceous matter, or soluble salts that must be removed at considerable expense by washing. Purified bentonite from different deposits and even from different levels or parts of the same deposit may have very different properties, such as variation in color, colloid content, and ease of hydration. In general, consumers want a clean, homogeneous, finely divided substance.

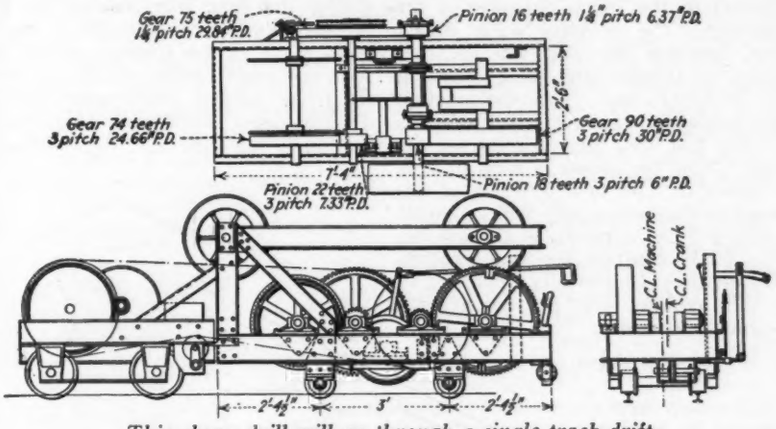
Characteristics of bentonite as an adsorbent, emulsifier, or peptizer should make it available in the manufacture of soaps and detergents, horticultural sprays, animal dips, insecticides, fungicides, paints, inks, water-proofing plasters and dynamite; in the de-inking of printed papers, the refining of oils and fats, and in the removal of water from petroleum. As a chemical reagent, bentonite should be of value as a water softener, as an aid to soil fertility, and in the treatment of molasses. It is also suggested for use as a medical dressing, in certain drugs, and in beauty clays.

Results of the investigation are given in Technical Paper 438 of the U. S. Bureau of Mines, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

USEFUL OPERATING IDEAS

Small Churn Drill Built for Underground Use

THE churn drill the general features of which are indicated in the accompanying drawing was designed and built by the Old Dominion Company for underground use, according to Charles Mendelsohn, mechanical superintendent. It was made small enough to go through a single-track drift of standard size without dismantling, except for detaching the truck carrying the motor from the churn-drill truck. The truck wheels are for 18-in. gage track, which is standard in the mine.



This churn drill will go through a single-track drift without dismantling

The approximate over-all dimensions without the motor truck are: length, 8 ft. 6 in., width 4 ft. 3 in., height from top of rail, 4 ft. 8 in. The drill will handle a string of tools weighing 900 to 1,000 lb. and will drill a hole up to 12 in. in diameter, but for effective work it is considered good for holes up to 8 in. in diameter and about 300 ft. deep. It is driven by a 6-hp. variable speed 250-volt, direct-current motor.

Sampling by Dry Stoper Proves Effective

IT HAS been found at the Pilares mine of the Moctezuma Copper Company that the ground and orebodies are adaptable to what is known as chicharra sampling, or sampling by means of a dry stoper, whereby holes are drilled into the orebody, and the dry cuttings assayed.

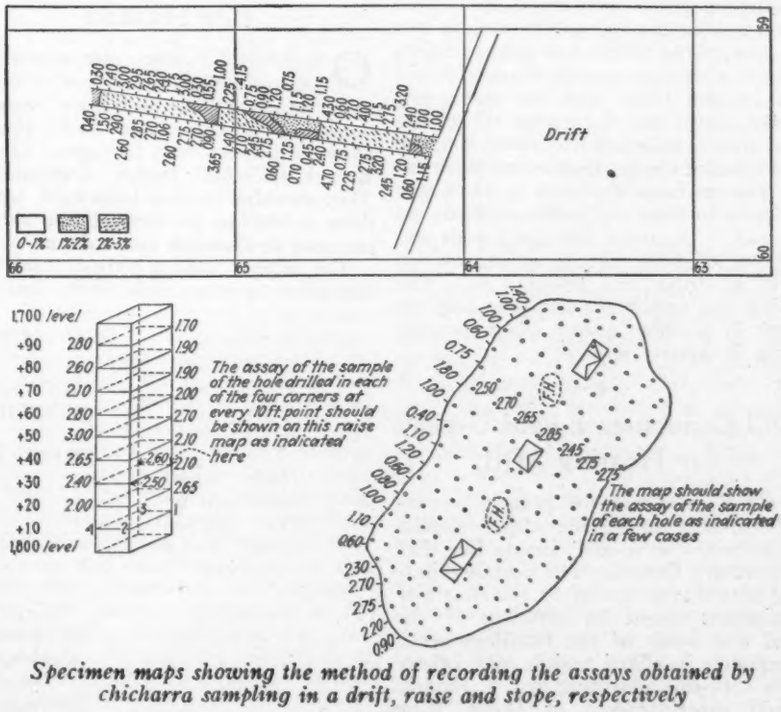
In stopes, 5-ft. vertical holes are drilled in the back, or 45-deg. holes in the wall of the stope, 5 ft. apart. In drives, 45-deg. holes, 5 ft. apart, are drilled along the wall. Vertical holes are sometimes drilled in the back. In raises, holes are drilled in the four corners of the raise every 10 ft. in height. A sketch of the stope, drive, or raise is made, showing the position and assay of the sample, as shown by the diagrams herewith. Colored wooden plugs indicating the grade of the ore are put into the holes of the stope, drive, or raise.

Another method of sampling raises, found to work satisfactorily, is to have the raise contractor catch the wet cuttings from the four corner holes during the drilling of the raise round. These are taken every other round. The samples are tagged, showing the date taken; and then from the engineer's measurement of the raise every week it is easy to plot the samples on the raise map within 1 ft. By this method, when the raise is completed it has been sampled and a great deal of time saved. Checks on this method have been satisfactory.

Grab samples of the broken ore check closely with chicharra samples. Between 1,500 and 2,000 samples are taken per month in stopes, drives, and raises. All sampling is paid for on contract.

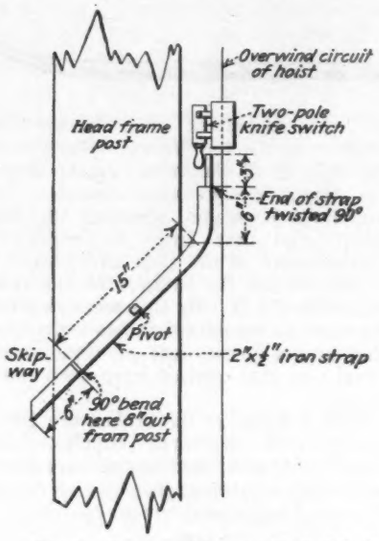
Another Safeguard Devised for Skip Hoisting

AFTER a skip has been dumped into the shaft pocket and is being dropped back into its normal vertical position in the shaft, it is not impossible for a rock to lodge between the skip body and the frame in which it is pivoted so as to prevent the body from resuming the vertical position. In this way the skip body, as it is lowered down the shaft, may be tipped sufficiently out of the vertical to strike the shaft timbers, damaging them severely or possibly ripping them out or even causing a worse



Specimen maps showing the method of recording the assays obtained by chicharra sampling in a drift, raise and stope, respectively

accident. To prevent this, the electrician (A. E. Keats) at the Porcupine Paymaster Mines, in Ontario, has installed a special switch in the overwind circuit on the headframe in such a



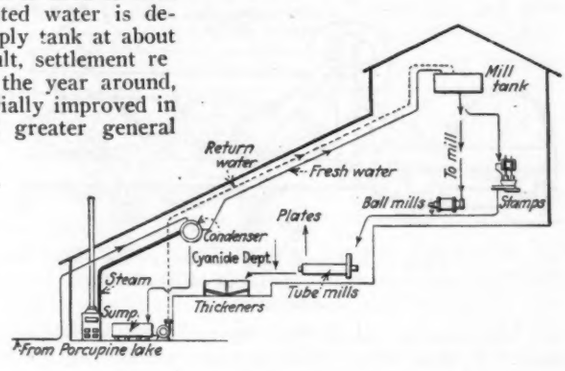
Device for breaking overwind hoisting circuit, when skip is out of plumb

manner that it is opened by the skip through the medium of a lever, if the skip is tipped. The switch, shown in the accompanying illustration, is simply a two-pole single-throw knife switch. In case of an occurrence such as the one described, the switch would be opened by the 2x½-in. iron strap shown, which is pivoted on the side of the post of the headframe and projects a few inches into the shaft compartment. This strap or lever projects sufficiently to come in contact with the roller on the side of the skip if the latter is tipped enough to strike the shaft timbers. By breaking the overwind circuit in this fashion, three things are accomplished: the oil circuit is opened, the brakes are set on the hoist, and the emergency brake is also set. Soon after this device was first installed, it was found that the vibration of the headframe was sufficient at times to cause the lever to move sufficiently to force the knife switch out of contact. To avoid this the simple expedient of tying the lever in position with a string was resorted to. The string was sufficiently strong to hold the lever in position, except when the skip came in contact with it.

Old Condenser Found Useful for Heating Mill

SOME provision for heating a concentrator during the winter months is necessary in a cold climate like that of northern Ontario. The heat of grinding plus that given off by the electrical equipment might be sufficient if the roof and walls of the buildings were adequately insulated against cold; otherwise not—this according to J. J. Jordan, mill superintendent of Dome Mines, Ltd. His company's plant at South Porcupine, Ont., has two 50-hp. boilers used for heating in the cold months. Formerly, low-pressure steam was piped to radiators placed at many points around the building. This method of heating, however, was unsatisfactory, as during the cold spells some spots were often near to the freezing temperature. Some other means was necessary.

It so happened that the company had in its power house an old condenser that had originally been used in connection with two 268-kva. generators which had supplied power when operation was started in 1912. This condenser was moved to a point in the mill where the supply of mill water, coming in from Porcupine Lake, could be passed through it. The steam from the boilers was then delivered to the steam chamber of the condenser. The incoming water supply varies between 300 and 400 gal. per minute, its temperature being anything from 34 deg. F. up. (Thus the function of the condenser was reversed. Formerly, its water had been used to condense the steam. Now the steam is used to heat the water.) The heated water is delivered to the mill supply tank at about 60 deg. F. As a result, settlement remains fairly constant the year around, amalgamation is materially improved in the cold months, and greater general efficiency is obtained.



Mill water supply heated by passing through condenser in reverse direction

Systematic Underground Inspection Reduces Fire Hazard

ON SHIFTS when the mines are not working, fire patrols of two men each, locally called "fire bugs," inspect the mine workings, writes F. H. Hayes, mine superintendent, Copper Queen Branch, Phelps Dodge Corporation. They examine the fire bulkheads, repair them if leaking, go through the stopes, and note fire hazards and bad conditions.

The patrols make a written report to the mine foreman each shift; and, in addition, carry with them special cards (Fire Patrol Daily Report), which are filled out and left in special receptacles at various places underground to check on their actual presence at these places. The shift boss on the following shift collects the cards and turns them in to the foreman, after noting the information and taking any necessary action. The two sides of the card used are shown.

FIRE PATROL DAILY REPORT

HOUR.....DATE.....

WORKING PLACE.....

CONDITION OF WORKING PLACE.....

.....

REMARKS.....

.....

.....

....

SIGNATURE OF SHIFT BOSS SIGNATURE OF PATROL

(over)

(Reverse)

Fire Patrol will fill in this report for each place designated by Foreman and leave this card in the working place.

The day Shiftboss will collect this card on first trip through working place and deliver to Foreman.

Daily report card used by fire patrol. Front and reverse

Solution Flow Measured in Ingenious Way

AT THE Dome Mines cyanide plant, South Porcupine, Ont., the tonnage of solution precipitated is measured by noting the time required for the level of the solution to drop 24 in. in the gage glass on the Crowe vacuum tank with the supply pump cut off, according to J. J. Jordan, mill superintendent. The diameter of the tank being known (60 in.), the rate that the solution is being drawn off by the triplex pumps can be calculated.

At the property mentioned the procedure is as follows: The butterfly valve controlling the inflow to the vacuum tank is first opened, causing the solution level to rise above the gage glass. The motor-driven centrifugal supply pump is then stopped by a remote-control switch. To measure the time required for the 24-in. drop in the glass a split-second watch is used. This method is sufficiently accurate for working results, and more accurate and also quicker than measuring the drop in a larger solution tank.

COMMENT AND CRITICISM

The Wire Gold Discovery South of the Porcupine District, Ontario

To the Editor of "E. & M. J.":

Specimens of crystallized gold in wire and mosslike forms were discovered recently on the D. A. MacKenzie claim, No. 13,683, in the township of Carscallen, southwest of Porcupine, which was staked Feb. 17, 1926. A specimen sent to the Ontario Department of Mines, Toronto, and shown in the accompanying illustration, measured 1¼x1x¼ in. and weighed 0.5581 oz. It is a beautiful aggregate of wires, twisted and curled about each other. Some of the wires are like twisted rope and others show minute protuberances which are

Specimen of crystalline gold, natural size

distorted forms of the cubic system, crystallization being extended in a linear manner along the wires. The gold is of 915 fineness.

According to Mr. MacKenzie, the specimen came from a composite vein of calcite quartz, and silicified rock—ribbed with minute veinlets of quartz—striking northeast and southwest between walls of carbonate-chlorite schist and an altered massive feldspathic porphyry. Near the vein are bands of iron formation.

Considerable alteration and leaching were in evidence at the surface as well as a black, pasty, oxidized substance from which gold could be freely panned. The wire gold was obtained after blasting. This gold appeared to adhere to well-crystallized quartz, showing pyramidal and prismatic forms, evidently formed in an open space, unlike most of the gold-bearing quartz in northern Ontario gold deposits.

Wire gold was also reported at the Beanland claim, about four miles from the MacKenzie claim and in the same township. These occurrences are probably unique in northern Ontario, where visible gold is usually found in massive form.

In nature, gold occurs in the native state, usually alloyed with a proportion of silver, and also in combination with tellurium and certain other minerals. Native gold is found in irregular masses, strings, scales, plates, and crystals, in quartz and other gangues, and is often associated with sulphides in so fine a state as to be invisible with the eye or microscope. Very rarely is gold known to occur in the crystallized condition when its form is that of the octahedron, or as combinations of forms of the cubic system.

Malcolm Maclaren, in his work on "Gold," refers to gold in crystal form having been found in the Urals, western North America, New Zealand, and elsewhere. He wrote:

"Regarded broadly, it rarely shows crystalline form, but where the conditions are favorable, as in cavities in the upper or vadose zones of fissures, or in loose, permeable, alluvial gravels, where expansion is not hindered by lack of space and where the directive lines of growth are not determined by the shape of the cavity or by the concurrent growth of another mineral like calcite or serpentine, gold obeys the natural laws of its crystal growth and crystallizes in various isometric forms. The largest and most perfect crystals are always derived from alluvial gravels. They may attain a length of 1½ to 2 in., in which case they are nearly always octahedra. . . . The gold crystals of the vadose zones of fissures are, on the whole, much smaller, much less perfect, and much more complex in aggregation, than those in alluvial deposits."

Maclaren gives an illustration of filamentary gold from a quartz vug, found in the Caledonian mine, New Zealand, and adds that wire gold may ordinarily be taken to indicate incipient crystallization along di-trigonal axes of symmetry, accompanied by abnormal elongation along those axes.

A. G. BURROWS,
Provincial Geologist.

Toronto, Ont.

The Causes of Unemployment

To the Editor of "E. & M. J.":

In your comment on my letter, "Passing the Buck," in the Jan. 12 issue, you say, "If Mr. Crocker opposes it"—the Foster-Catchings plan—"he must oppose life and fire insurance as well, the basis of which is the same." I would point out that unemployment is not an act of God, as you imply when you compare it with fire and death. It is man made. It is not so unavoidable that we must try to distribute its evil effects over time and space by some such plan as the Foster-Catchings plan. It is not a question of distributing unemployment, but a question of why we have unemployment at all. The present economic system by its buck-passing action is not only responsible for unemployment but is also responsible for its unequal distribution. As I said in my letter, the man who suffers most in buck-passing is the man who is the least able to pass the buck. The Foster-Catchings plan or any other plan that does not remove the ability of some to shift economic burdens onto the shoulders of others can never solve the problem of unemployment. So strongly intrenched is the present economic system that any plan designed to overcome the evil effects of its characteristic buck-passing action must be overcome and its action nullified by this same buck-passing.

You state that "public works are not merely ornamental. They serve a highly useful purpose and are the instruments of prosperity." The question of whether public or any other kind of works are useful or not does not enter here. It is a question of why, no matter how greatly the national wealth is increased, there is unemployment, poverty, and want. Why is there want in the midst of plenty? WM. CROCKER.

Prescott, Ariz.

[Mr. Crocker assumes that an economic revision could solve the problem of unemployment, but overlooks the fact that its causes are not all economic. The weather, science, the discovery of new natural resources and the exhaustion of old all enter into it. Our education, which makes us specialists in so many different fields, renders us helpless when our particular branch of knowledge becomes obsolete. These conditions will exist, regardless of the current economic structure—be it capitalist, socialist, or anarchist. The Foster-Catchings scheme is not designed to prevent unemployment, as our correspondent apparently assumes, but merely to ameliorate its effects. We agree with Mr. Crocker in feeling that unemployment is a malady of some sort, but we differ in our diag-

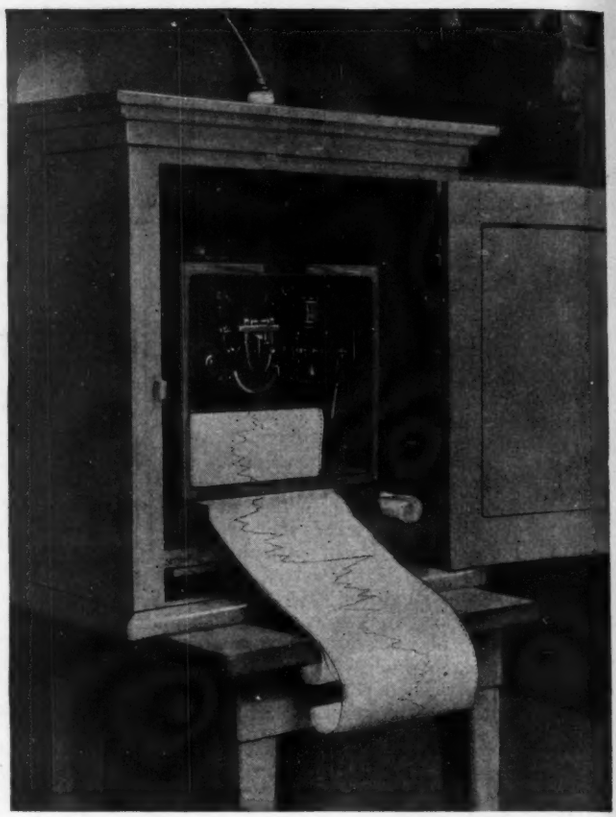
noses. He sees it as an unhealthy growth and proposes an immediate operation. Messrs. Foster and Catchings, fearful lest an operation prove fatal, propose the use of an artificial stimulant such as government aid. Here, however, the question is not one of cure but of prevention. The solution, if there be one, lies in the education of employer and employee—as suggested by Mr. Sam Lewisohn in his speech at Geneva, published in *Engineering and Mining Journal* of Jan. 26—so that they realize their interdependence; and in the adoption of unemployment insurance, old-age pensions, and employee stock ownership on a broader scale. But even these palliatives will hardly do away with the evil. So long as industry remains in a state of flux, regardless of its economic foundation, unemployment seems almost certain to persist. And if we ever do reach a status quo, that Utopian condition preached by philosophers and social economists, life might be safe but it would probably be unbearably dull.—EDITOR.]

Recording Instruments and Flotation Reagent Control

To the Editor of "E. & M. J.":

In an editorial in the Dec. 22 issue of *Engineering and Mining Journal* you say that "Automatic reagent control, by means of automatic hydrogen or hydroxyl ion recording instruments, was recently suggested. In a few years, one may see this in successful operation."

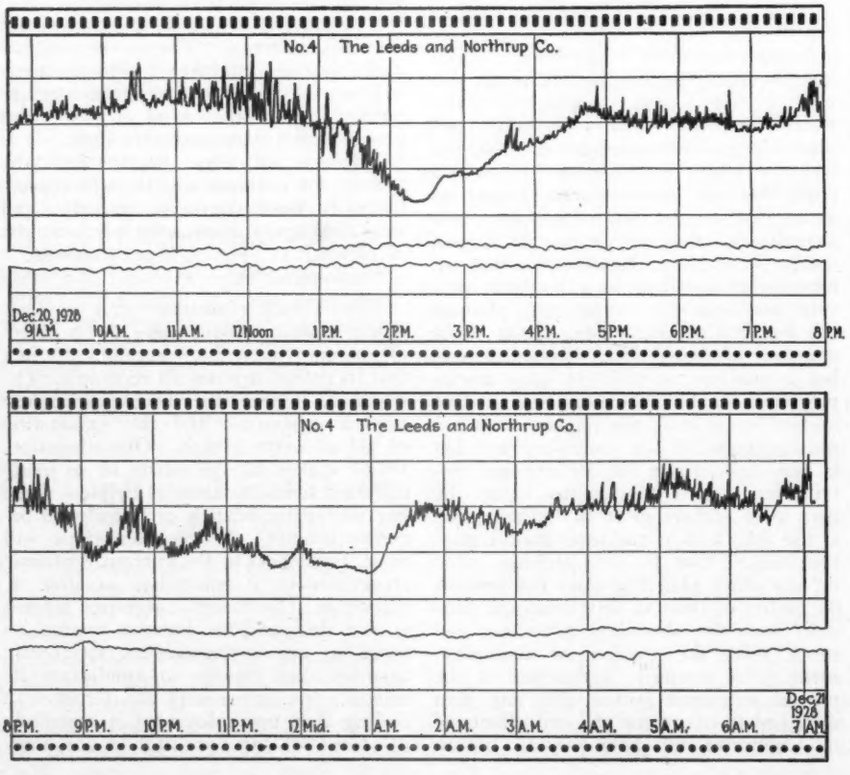
One means of achieving this is suggested by a recording instrument which was put in operation at Nacozari in 1924, and which was mentioned by Mr. W. T. Macdonald in his article published during that year, entitled "Selective Flotation at Nacozari." He mentioned it again in the recent Phelps Dodge Number, though no details were given.



Leeds & Northrup instrument in use at the Nacozari mill of Moctezuma Copper Company

The instrument referred to is a recording conductivity meter made by Leeds & Northrup. It is essentially a self-balancing Wheatstone Bridge, and measures the electrical conductivity of the water portion of the flotation heads pulp. Under local conditions, lime is the only dissolved salt subject to appreciable variation from hour to hour, and we find by check titrations that the conductivity graph is indeed a reliable index to alkalinity variation. Hence, when the instrument is in use, the operator may see at any instant the trend of his alkalinity and has a graphic continuous picture of its variation.

Graph of variation in pH measurement of flotation heads, Nacozari mill, for the 22-hour period ending 7 a.m., Dec. 21, 1928


No.4 The Leeds and Northrup Co.
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No.4 The Leeds and Northrup Co.
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Dec.21 1928

The instrument is equipped with automatic alarm contacts which may be set at any desired maximum and minimum. It would be simple to arrange this secondary circuit so that it should actuate a change in the rate of lime feed, as well as to operate a signal. This was considered at the time the instrument was put in, but was not done, as the flotation circuit is operated at an excess of alkalinity which does not necessitate this refinement, and as the alkalinity requirement also varies.

A sample graph as given by the instrument is shown herewith. This is not graduated in absolute units, because the only matter of operating significance is relative change. E. H. ROSE.

Nacozari, Son., Mexico.

[Mr. Rose's comments are so interesting and welcome that no regret can be felt that they were occasioned by a misinterpretation for which we plead guilty. The value of the recording instrument of this type in the more precise adjustment of the factors of alkalinity and acidity in flotation pulp is well recognized, and much credit is due to the technicians and technical executives on the staff of the Moctezuma Copper Company for their keenness and ability in attacking this problem as well as for the generous spirit shown in their willingness to make the results known to others. Had the sentence quoted been phrased more aptly we would have conveyed the thought we desired to convey: that the

actual control of the condition of the pulp, with respect to hydrogen or hydroxyl ion content, might be effected entirely by automatic means. In other words, we foresaw the development of an instrument, the value of which had been anticipated at Nacozari, that both recorded and controlled, operated in much the same manner as does the unit now available, for instance, to maintain the desired temperature of a pulp by the automatic adjustment of steam used for heating the pulp, the result being checked by a continuous graph record of actual temperature maintained.—EDITOR.]

By The Way

Mining Interests Cover Wide Geographic Range

A RECENT evening devoted to reminiscing by members of the San Francisco section of the Institute brought into prominence a wide geographic and historic range of achievement. Mr. F. W. Bradley stated that in his ramblings about Nevada County he had found the trees that served as snubbing posts where the emigrants of the California gold rush had lowered their wagons from the ridges to the flats. The improvement in gold mining that followed the introduction of the Frue vanner and the Challenge ore feeder, which occurred in Mr. Bradley's time, marked the beginning of a development of milling methods and milling equipment that has kept pace with the exacting conditions of the industry. Continuous operation crowded out intermittent operation. Mechanism displaced hand methods. Mr. Charles W. Merrill participated in the early development of the cyanide process and was responsible for many improvements in practice and mechanism. He described the early conditions at Bodie and at the Homestake.

In geographical range the reminiscences of seven engineers comprised Indla, Western Australia, Mexico, Canada, Russia, Alaska, and the Western mining states, but only a small part of the activities of those who spoke could be presented. If the entire experiences of this small section of the mining fraternity could be brought together, they would be found to cover a considerable portion of recent mining history and the majority of the significant advances in mining and milling practice.

Another Relic of the Comstock Passes Into the Limbo

THE historic office building and assay office of the Con. Virginia Mining Company at Virginia City, Nev., through which has passed gold and silver bullion to an amount estimated as high as $300,000,000, soon will be only a memory. This temporarary "treasure house" of bonanza days, where bullion was melted into bars for shipment from the big bonanza of Mackay and Fair, has been sold to W. J. Bracking, of Reno, and recently a contract was let for its dismantling. The lumber will be utilized for the construction of a mill for the Premier mines, near Carson City, Bracking said, and for the building of bunk houses for employees.

The office building and assay office of the world-famous mine is located south of the old Con. Virginia shaft and east of the railroad station of the Virginia and Truckee railway. It was built during the 70's and is adjacent to the main surface workings of the shaft through which a large part of the ore from the bonanza stopes was hoisted. The old building also housed the private office of John W. Mackay. Only recently a safe belonging to Mackay was removed from the structure and placed in the museum of the Mackay School of Mines at the University of Nevada. The old scales on which were weighed the bullion bars at the assay office also recently were added to the Comstock section at the school museum, as was the sawed-off shotgun used by the bullion guards.

For years the minimum value of bullion handled through the office reached a fabulous sum daily. The largest monthly production, of more than $2,000,000, in June, 1876, during centennial year, is said to have established an all-time record.—*Nevada State Journal.*

The Nines Have It!

YEARS ending with a "9" have been momentous ones in the American mining industry. The California rush of '49; the Comstock and Pike's Peak strikes of '59; the Eureka and White Pine excitements of '69; the Bodie, Tombstone and Leadville booms of '79, and the Cripple Creek strike of '89 are remembered by all old-timers. By '99 the Klondike boom was on the wane, but it was only a few months after the close of that year that the big strike at Tonopah occurred, and I believe that Nome came on the map about the same time. In 1909 we had the Ely, Rawhide and Jarbridge booms, and in 1919 the Divide excitement.

My reason for believing that 1929 will prove no exception to the rule is founded on no superstition about "lucky numbers," but upon the enormous area of mineralized ground in which miners and prospectors are constantly at work. Take the State of Nevada alone, with its 112,000 square miles of territory, mostly mineral land in which the stroke of a miner's pick or the blow of a prospector's hammer may uncover a second Comstock or Tonopah.

But even without new finds, we are doing very well, with many mines in actual operation; and I believe that the biggest, most favorable factor in their interest is the approaching administration of President-elect Hoover. Now for the first time we are to have a President who is in sympathy with the mining industry; a sympathy based upon understanding, for his long experience in the mining business began right here on the Pacific Coast. Under his régime the precious metal mining industry will no longer remain the stepchild of the government, for I am sure that President Hoover will lend a helping hand toward the removal or amelioration of the burdens of the mining men, particularly in the matter of taxation—H. E. Epstine, president of the San Francisco Mining Exchange, in the *San Francisco Chronicle.*

Consultation

Eastern Smelters

"Can you give me a list of smelters, east of the Mississippi?"

The following list is substantially complete and accurate so far as the primary smelters are concerned. There are many other plants handling chiefly secondary material and various ferrous materials.

Copper—Calumet & Hecla Consolidated Copper, Hubbell, Mich.; Michigan Smelting, Houghton, Mich.; Quincy Smelting Works, Hancock, Mich.; Ducktown Chemical & Iron, Isabella, Tenn.; Tennessee Copper, Copperhill, Tenn.; American Metal (U. S. Metals Refining), Chrome, N. J.; Nichols Copper, Laurel Hill, Long Island, N. Y.; American Smelting & Refining, Maurer, N. J.; International Nickel, Copper Cliff, Ont.; Mond Nickel, Coniston, Ont., and Horne Copper, Noranda, Que.

Lead—American Smelting & Refining, Maurer, N. J. and Federal, Ill.; American Metal (Balbach Smelting & Refining Works), Newark, N. J.; National Lead (St. Louis Smelting & Refining Works), Collinsville, Ill.; and Kingdon Mining, Smelting & Manufacturing, Galletta, Ont.

Zinc—American Steel & Wire, Donora, Pa.; American Metal (American Zinc & Chemical), Langeloth, Pa.; American Zinc, Lead & Smelting (American Zinc), East St. Louis, Ill., Columbus, Ohio, and Hillsboro, Ill.; Eagle-Picher Lead, Hillsboro, Ill.; Grasselli Chemical, Terre Haute, Ind., and Meadowbrook, W. Va.; Hegeler Zinc, Danville, Ill.; Illinois Zinc, Peru, Ill.; Matthiessen & Hegeler Zinc, La Salle, Ill.; New Jersey Zinc, Depue, Ill., and Palmerton, Pa.; and United Zinc Smelting Corporation, Moundsville, W. Va.

Silver-Cobalt—Deloro Smelting & Refining, Deloro, Ont.

Aluminum — Aluminum Company of America, with plants at East St. Louis, Ill.; Niagara Falls, N. Y.; Massena, N. Y.; Marysville, Tenn.; Badin, N. C.; Shawinigan Falls, Que.; and Arvida, Que.

Some of these may not be considered strictly as smelters, but most if not all of them are ore-treatment plants. There are also several plants, not included in the above list, that make ferro-alloys.

INDUSTRIAL PROGRESS

Electrical Development in 1928

In Mining and *Welding*

By
F. L. STONE

and

K. H. RUNKLE
General Electric Company

PROBABLY the most interesting installation of electric equipment in any mining operation during 1928 was that involving the complete electrification of the Bingham, Utah, mining properties of the Utah Copper Company, in connection with which a minimum of twenty and a maximum of approximately forty electric locomotives will be installed. Although the actual mining operations are already electrified, utilizing electric shovels, the haulage system of the property has until recently been of the steam type. When completed, the project will be the largest electrified metal mine in the world, and will involve the largest number of electric locomotives ever applied to an open-cut mining operation.

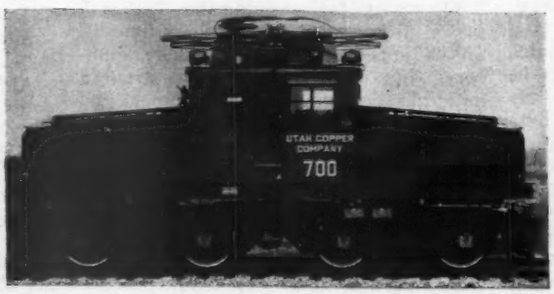
The decision to change over from steam to electric haulage, electrifying the entire project, followed a test of about a year with a trial installation of a 75-ton combination storage-battery, trolley, and cable-reel locomotive. This preliminary electrification worked out so satisfactorily that the Utah company decided on an initial installation of twenty locomotives of similar type, to be put in operation as early as possible. Additional locomotives will be put in service later. Of the first twenty, however, two only will be equipped with storage batteries, as was the original trial unit, the remainder omitting this accessory and drawing power from overhead and side-arm pantograph trolleys or from trailing cable.

The original locomotive was especially designed for service at this mine, the peculiar arrangement of the benches making it advisable to try out each and all of the power collection devices described. The additional locomotives, with the exception of the first two, will collect power from the trolleys or via trailing cable, as the proposed electrification eliminates the necessity of a storage battery.

Typical 12-cu.yd. electric shovel of Marion make

Power for the locomotives will be supplied from two substations, also to be constructed, and an extensive electrification system will be necessary for distribution to the points where this power will be needed. The electric locomotives will haul the ore cars up the side of the mountain over switchbacks, to the various benches and to the shovels where the cars will be loaded and hauled back down to the foot of the mountain. There the ore cars will be made up into long trains and transported to the mill over the Bingham & Garfield Railroad.

One of the new electric locomotives for Utah Copper Company



By
L. S. THURSTON
General Electric Company

The new locomotives are described as being of the articulated truck, steeple-cab type, with rigid frame, made up of heavy steel-plate sides carried on combination semi-elliptic and helical springs. The main cab of the storage-battery locomotive is over 10 ft. square, and in this cab is the engineer's seat and control stations, with necessary electric equipment.

Four large totally inclosed electric motors drive each locomotive, the motor armatures running on roller bearings. These motors are controlled by a single-unit, three-speed control arranged for series, series parallel, and parallel operation, with resistors of sufficient capacity for the specified service cut in and out by solenoid-operated contactors of proper size to open and close the power circuits. Complete protection and metering equipment is provided by suitable relays and instruments.

The overhead pantograph trolley on each locomotive is raised by a spring and lowered by air. Both operations are controlled by the engineer in the cab. In addition, there are two side-arm pantograph trolleys, one mounted on each side of the cab room. These trolleys are extended and withdrawn by air, under control of the engineer.

The electric cable reel, mounted under the platform beneath the cab, carries a suitable length of flexible rubber-covered cable, and is of the vertical axis type, driven by a motor which automatically winds and unwinds the required length of cable as the locomotive moves toward or away from the source of power. The cable is taken from the reel through cable guides and attached to the source of power.

In the storage-battery locomotives, a ball-bearing battery-charging motor-generator set in the locomotive cab is arranged

Typical 12-cu. yard electric shovel of Bucyrus make

to charge the battery through its control without the use of a charging resistor, and is complete with all the necessary control and protection.

A two-stage railway-type air compressor, also in the locomotive cab, provides the necessary air for operating the double-end locomotive air-brake equipment.

The locomotives without storage batteries will be practically identical with those described except for the battery, charging equipment, and other accessories not needed when the battery is not used.

Larger Electric Shovels

During 1928 there was put into successful operation electric equipment for the first 12-cu.yd. shovel, and since then a number of other properties have decided to install equipment of the same size, some of which are already in operation and others in course of construction. The largest excavating machine of this type, previous to that time, was the standard 8-cu.yd. shovel, which has, in one or two instances, been fitted with a 10-cu.yd. dipper.

Electric equipment for the 12-cu.yd. shovel is of the special variable-voltage (Ward Leonard) type standardized for shovel service. The motor-generator equipment involves a four- or five-unit set consisting of an 800-kva., 800-hp., 3-phase, 60-cycle, 4,000-volt, 1,200-r.p.m., synchronous motor driving hoist, swing and crowd generators of the following ratings:

Hoist generator: 400 kw., 600 volts, differential compound wound.
Swing generator: 200 kw., 600 volts, differential compound wound.
Crowd generator: 150 kw., 250 volts, differential compound wound.
Exciter: 35 kw., 125 volts, constant voltage.

New features in the generator design for this service have provided characteristics exceptionally well suited to handling the extreme variations in current demand encountered in shovel work.

The motor equipment is as follows:

Hoist: Two mill-type, 200-hp., separately excited motors operating with armatures connected in series.
Swing: Two mill-type, 100-hp., separately excited motors.
Crowd: One mill-type, 150-hp., continuous-rated, separately excited motor.

These motors are all a new design of mill motors using roller bearings and inbuilt fans. The design is the same as for standard steel-mill motors, except that the length along the shaft has been decreased appreciably to fit in better with the mechanical layout of the shovels.

Auxiliary equipment includes such items as dead-front, steel, cabinet-type switchboard, railway-type reciprocating air compressor, special shovel-type transformers and controllers, and various other small items.

The operation of the 12-cu.yd. shovels, all of which have thus far been used in coal-stripping work, has been successful from the first, and the use of this size machine undoubtedly marks a forward step in open-pit mining. One of these shovels has made a world's record for material moved by an excavating machine of this kind. It moved a total of 15,497 cu.yd. of overburden in 24 hours, divided into three eight-hour shifts.

During the year there was built for the United Electric Coal Company of Danville, Ill., a 15-cu.yd. power shovel, the largest in the world as to dipper capacity, physical size, output, and power. This machine, not yet completed, will be 20 per cent larger in dipper capacity than any other machine of its type heretofore designed, but the actual increase in power involved is about 100 per cent, on account of the correspondingly increased working range of the machine as compared to the 12- and 8-cu.yd. machines. This shovel, to be used in the open-pit mining of coal, is being built by the Marion Steam Shovel Company.

The shovel will receive power through a 3-in. trailing cable approximately 1,000 ft. long. The power supply will be in the form of alternating current at 4,000 volts. This will drive a five-unit motor-generator set consisting of a motor, three generators and an exciter, rated as follows:

Driving motor: 10-pole, 1700-kva., 0.8-power factor, 3-phase, 60-cycle, 4,000-volt, synchronous motor.
Hoist generator: 8-pole, 860-kilowatt, 720-r.p.m., 500-volt, differential compound-wound.
Swing generator: 4-pole, 350-kw., 720-r.p.m., 700-volt, differential compound-wound.
Crowd generator: 4-pole, 350-kw., 720-r.p.m., 700-volt, differential compound-wound.
Exciter: 6-pole, 50-kw., 720-r.p.m., 125-volt, compound-wound.

This motor-generator set is built with a self-supporting, three-point suspension base, an innovation in shovel design. The entire set was compactly built to occupy but 24½ sq.yd.

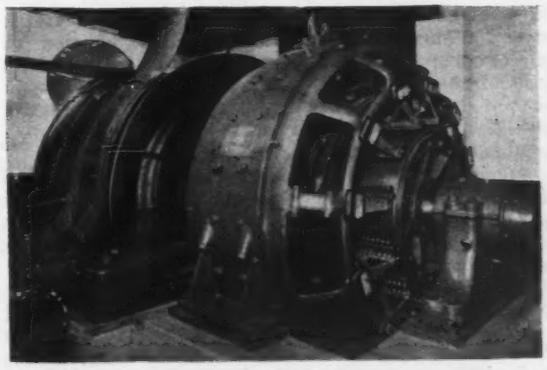
The shovel operations will be performed by the following motors:

Hoist: Two steel-mill type motors, 8-pole, 450-hp., 212/450-r.p.m., 230-volts, separately excited.
Swing: Two mill-type motors, 175-hp., 400-r.p.m., 230-volts, separately excited, including blowers for forced ventilation.
Crowd: Two mill-type, 175-hp. motors, in general the same as the swing motors except that covers and forced ventilation features will be such as to make them suitable for outdoor mounting.

The total weight of the set is 130,000 lb., and the weight of the self-supporting base alone is 42,000 lb.

Electric Hoists

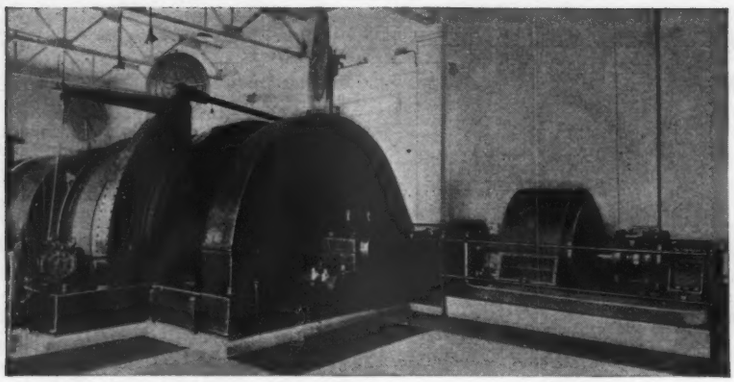
Few developments in the mining industry in 1928 required unusual or outstanding electric hoisting equipment. The Peabody Coal Company, of Chicago, installed, at its No. 53 mine, Springfield, Ill., a hoist which is worthy of note because of the high rope speed and number of trips made per hour. It is operated by the variable-voltage (Ward Leonard) system of control and consists of an 850-hp., 116-r.p.m., direct-current motor direct-connected to the hoist drum and a 750-kw. synchronous motor-driven generator set for supplying the direct current.



Electric hoist at Mine No. 53, Peabody Coal Company, Springfield, Ill.

The equipment was designed to make 230 trips per hour from a depth of 282 ft. and, to do this, the rope speed reaches 3,300 ft. per minute. The hoisting cycle is made up as follows: 5 sec. acceleration, 1.65 sec. full-speed running, 5 sec. retardation, 4 sec. caging—a total of 15.65 sec.

The control is of the magnetic type, with a master switch for handling the contactors. Time-limit relays are provided to limit the closing and opening



Fabricated steel frame induction motors installed for hoisting service by Oliver Iron Mining Company

of the contactors to values which will prevent excessive current from being taken by the hoist motor.

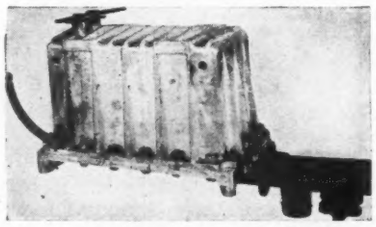
An 1,800-hp., 360-r.p.m., 3-phase, 60-cycle induction-type hoist motor is being built for the Tennessee Coal, Iron & Railroad Company, Birmingham, Ala. This motor will be a duplicate of two equipments already installed, except that the new motor will be equipped with magnetic control, whereas the previously installed units used liquid rheostats. This is the largest induction mine hoist motor with magnetic control installed in this country, and there is reason to believe that no larger equipments of similar design have been made in any other country. The control provides dynamic braking to allow for lowering loads at reduced speeds without excessive wear of the mechanical brakes.

A duplicate of its present hoisting equipment is being built for the Miami Copper Company, of Miami, Ariz., to be used in conjunction with the present equipment to increase the speed of the hoist and the output of the mine. The new equipment consists of a 1,400-hp., direct-current motor for gearing to the hoist drum, a 1,000-kw. induction motor-driven generator set with a 50,000-lb. flywheel, and control to provide full-automatic operation of the hoist.

During 1928 the first fabricated steel-frame induction motors were installed in mine hoisting service. The accompanying photographs show two of these motors installed at the Oliver Iron Mining Company's mines in Minnesota and Michigan.

New Permissible Motor

In 1927 there were built, in accordance with the requirements of the U. S. Bureau of Mines for permissible apparatus for use in gaseous mines, motors in sizes of 1, 3, and 5 hp., direct current. During 1928 this line was extended to include a 15-hp. motor of the same type of construction. This motor has been applied to large underground conveyors for handling coal and materials and, for this purpose, requires a reversing control unit inclosed in a case built in accordance with the requirements of the U. S. Bureau of Mines for this service. The control unit includes master switches for starting and for reve sing, two line contactors and one series accelerating contactor, a starting resistor, an overload relay, and a temperature relay, the latter opening the circuit in case the starting resistor is kept in circuit too long and thus reaches a high temperature. These relays are reset mechanically by means of a rod and lever operated by turning the operating cylinder of the master-switch counter-clockwise from the



Control equipment for permissible 15-hp. motor

"off" position. Thus the relays cannot be reset in the "start" or "run" position. This equipment has been developed for 250 volts, direct current. The 15-hp. motor is available for either 250 or 500 volts.

Another Long Conveyor

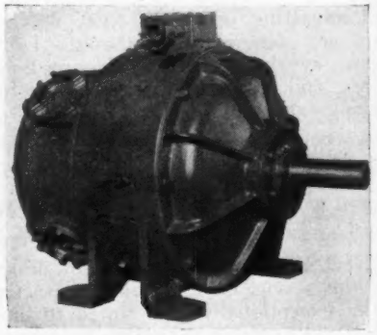
The H. C. Frick Coke Company put into operation during 1928 a conveying equipment approximately 2½ miles long, for transporting coal from the mine to a dock on the river. It consists of twelve sections varying in length from 340 to 2,217 ft., and was designed to deliver 1,800 tons of coal per hour. The electric equipment consists of three 300-hp., three 200-hp., and four 175-hp. motors; also one 125-hp. and one 75-hp. motor, all 3-phase, 60 cycles, wound-rotor type induction machines, with control and switchboard.

Electric Welding Makes Progress in Steel Fabrication

The outstanding development in electric arc welding during 1928 was the decided stimulus it received in its application to the fabrication of steel buildings. The development, during the latter part of the preceding year, of a welded roof truss, together with the ability to use structural steel columns and girders without difficulty in a welded structure, made considerable progress possible.

From a popular standpoint, the advantages of eliminating the din of riveting, by the use of a silent method of welding, are obvious. From a practical standpoint, the electrically welded structure has been proved to be beyond the experimental stage. Design can be calculated in advance, as is evidenced by the existence of almost 50 welded steel buildings now in use, in none of which have failures occurred. Experience during the year proved that the welded structure can be made with less material than the riveted structure for the same loads and safety factors and that, as shop methods are developed, it will be possible to fabricate buildings by the use of welded joints cheaper than by the use of riveted joints. This, it is expected, will lead to the use of welding as a means of economy.

The most impressive application of electric arc welding to building construction completed during the year was the fabrication and erection of a 1,000-ton factory building for the General Electric Company at its new plant in West Philadelphia. This building, now completed and occupied, involved at the time of its erection a number of new design features, including the use of the welded roof truss. The structure is approximately 140 ft. wide, 600 ft. long, and 50 ft. high. The principal elements from which the building framework was constructed were welded in the shops of the American Bridge Company, at Trenton, N. J. These were delivered to the building site, and the remainder of the work necessary to fabricate them into the form of the completed structure was done on the spot with field welding. Two portable welding sets were all that was required during most of the field welding, although three were used at times. Most of the welding was done with ⅜-in. fillet welds, though $\frac{5}{16}$-in.



Permissible 15-hp. motor for gaseous mines

fillets were used to some extent. Following the erection of the West Philadelphia building, two more factory buildings of smaller size were erected, also for the General Electric Company. Another interesting application of welding in this field was made during the year by the Dallas Power & Light Company, which erected, at Dallas, Tex., a 40-car welded garage for the

protection of employees' cars. By utilizing structural steel that would otherwise have been scrapped, the total cost of erecting this structure was reduced to but 25 per cent of the lowest contract price for an equivalent riveted structure. A single portable welding equipment was all that was necessary to do the work. This garage is made of steel angle-iron framework covered with corrugated galvanized iron. There are two units, each 16 by 140 ft., divided into ten spans each 14 ft. wide, and each unit capable of covering twenty cars. The units face each other with a 22-ft. driveway between. All steel used was salvaged from the framework of an outdoor switching structure which became obsolete with the addition of generating equipment to the power plant. The varying lengths of the steel members removed from this structure, together with the numerous holes already punched for the switching structure (which would have interfered with the punching of new holes to fit the garage design), would have made it necessary to splice or junk the greater part of the steel if a type of construction other than welding had been used. As the company had in its possession at the time a portable welding equipment, to fabricate the structure by welding was a simple matter.

A further impetus, during 1928, to this art was given by the design by Frank P. McKibben, consulting engineer, Black Gap, Pa., of a welded plate girder which, according to his calculations, affords a saving of 15.2 per cent in the weight over the riveted type.

A marked improvement in the technique of welding pipe lines was the result of the construction, during 1928, of such a line to supply water to the city of Springfield, Mass., from a point 7 miles away. Dropping more than 300 ft. in elevation, this line passes under the Connecticut River on the way, and is the longest welded pipe line in the east. Pipe sizes vary, including diameters of 36, 42, 48, and 54 in. The plate used varies in thickness from $\frac{5}{16}$ to $\frac{1}{2}$ in. Welding was accomplished automatically by the multiple-arc process employing two arcs, one following about eight inches behind the other. By using two travel carriages, with a total of four arcs working simultaneously, a 50 per cent saving in welding time per pipe was effected over that necessary with one travel carriage and two arcs.

An interesting development in the railroad field in 1928 was the extension of the use of the welded metal railroad tie to switches, cross-overs, and other types of track. This form of tie, fabricated from scrap rail and believed to be much less expensive than the common wooden tie in many applications, was first announced in 1927, when a trial section of track was equipped with welded ties by the Delaware & Hudson Railroad. The extension of application in 1928 was made at the entrance of the D. & H. R.R. Co.'s tracks to the plant of the General Electric Company in Schenectady. Up to that time, such ties had been used on straight track only. The new installation includes all types of track which are commonly used in railroad service, with the exception of track involving the signaling function, on which development work is still in progress. Not only were the switches and cross-overs mounted on metal ties, but the switch stands themselves were mounted on extra long metal ties. By a simple arrangement the base on which a switch stand is fastened was welded to the ties, resulting in a firmly fastened stand, but allowing its easy removal for replacement or repair if necessary.

The Delaware & Hudson Railroad Company maintains a metal-tie fabricating shop at Colonie, N. Y., built around an automatic arc-welding machine specially designed and constructed by the G. E. company for this product. Its present output is about 20,000 ties per year, which production is entirely covered by requisitions from the various operating divisions. Metal ties were adopted as standard, during 1928, by the Delaware & Hudson Railroad for everything except signal track.

New Welding Equipment Introduced

An improved combination of electric arc welder and Fordson tractor, announced during 1928, involves a new type welding equipment and the addition of head and tail lights and a protective cover. The unit consists of a standard Fordson tractor belt-connected to a type WD-300-A, 25-volt, 300-amp., one-hour rated 1,750-r.p.m., ball-bearing generator. The welding generator is mounted directly on an extended frame of the tractor and is protected from the weather by a metal canopy and canvas side curtains. The over-all length of the complete unit is 12 ft.; the height is 4 ft. 8 in.; the width is 5 ft. 2 in., and the net weight is approximately 4,900 lb.

An improvement was announced in 1928 in the control equipment used with automatic arc-welding heads, by means of which the feed of electrode wire is stopped a short time before shutting off the welding current at the end of the weld. This serves two purposes: first, it clears the electrode from the weld, and, second, it fills in the crater which is usually left at the end of the weld when the arc is cut off short. Such an improvement is particularly desirable. By keeping the electrode clear of the weld when removing the work from the clamping fixture, the end of the wire is prevented from dangling—a feature of particular importance with large sizes of wire. The undesirable crater is also objectionable, especially on circular welds of small diameters where one end of the weld is lapped over on the other end. Control of this equipment is simple, involving the use of only two push buttons.

PATENTS

APPARATUS FOR DRY CONCENTRATION. No. 1,699,382. Jan. 15, 1929. Henry Moore Sutton, Walter Livingston Steele, and Edwin Goodwin Steele, Dallas, Tex.

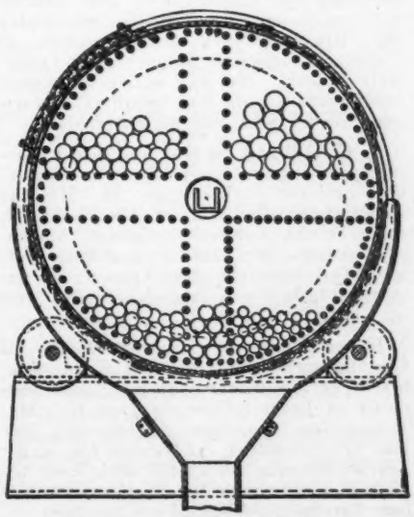
A pneumatic-table method of ore concentration.

SIZE OF ORE PARTICLES. No. 1,697,867. Jan. 8, 1929. Herbert E. T. Haultain, Toronto, Canada.

An apparatus for determining variations in the average size of ore particles in an ore pulp flowing in a launder.

COMBINED GRIZZLY AND BALL MILL. No. 1,697,531. Jan. 1, 1929. Arthur F. Levitt, Los Angeles, Cal.

This covers a rotatable drum containing a series of bars placed lengthwise in transverse and peripheral alignment. These bars form a grizzly and compartments containing balls of various sizes.



Sketch of combined grizzly and ball mill

METHOD OF GRANULATING MOLTEN SLAG. No. 1,699,575. Jan. 22, 1929. Friedrich Wilhelm Emil Spies, Velsen-Noord, Netherlands.

Molten slag is first converted into a spongy mass by bringing it into contact with water. This mass is then exposed to a relatively cool stream of gas that changes the spongy mass to a substantially dry, granulated material.

PROCESS AND APPARATUS FOR WET-MAGNETIC SEPARATION OF ORES ON DRUM SEPARATORS. No. 1,697,375. Jan. 1, 1929. Georg Ullrich, Magdeburg, Germany, assignor to Fried. Krupp Grusonwerk Aktiengesellschaft, Magdeburg - Buckau, Germany.

This patent covers a wet magnetic separator comprising a rotating and channeled separator element, means for delivering a fluid to the side walls of the channel, feeding device above the channel, and a liquid jet directed transversely through the material to be separated as it falls to the separator element.

REMOVING COPPER OXIDE FROM COPPER. No. 1,698,443. Jan. 8, 1929. Hiram S. Lukens and Russell P. Heuer, Philadelphia, Pa.

In this process molten copper is continuously deoxidized, and at the same time it is kept free from additional impurities. A slag capable of taking up copper oxide from the molten copper is formed and is treated in place for the reduction of its copper-oxide content. Reduction of the copper oxide in the slag, and the extraction of copper oxide from the molten copper by the slag, are effected without adding any of the initial slag to the copper.

Personal Notes

J. H. Curle recently left London on a trip through Brazil, Argentina, northern Chile, Bolivia, Peru and Venezuela.

Glenn L. Allen, metallurgical engineer with San Francisco Mines of Mexico, sailed on Feb. 2 from New York for London.

C. O. Anderson, metallurgist, of the Century Zinc Company, Baxter Springs, Kan., was in New York City last week on company business.

Raymond Brooks has sailed from New York for London. He will visit the Rhodesian and South African mining districts before returning.

W. C. Browning, formerly manager of Magma Copper, at Superior, Ariz., and now consulting engineer in Los Angeles, is in New York for a few weeks.

William J. Colenso has been appointed office manager for St. Mary's Mineral Land, with headquarters in Houghton, Mich.

James G. Ross, consulting mining engineer, of Montreal, Canada, was recently in San Francisco en route to his home from Arizona.

F. Le Roi Thurmond has been appointed superintendent of Venus Silver Mines, operating in the Deer Trail district, near Fruitland, Wash.

John L. Alexander, manager of Regal Asbestos, at Chrysotile, Ariz., recently married Miss Marian Williams, daughter of W. F. Williams, chief clerk of Miami Copper, at Miami.

Dr. E. U. von Buelow, who recently resigned as vice-president of North American Exploration, has opened offices as consulting geologist and geophysicist at 509 Seventeenth St., Denver, Colo.

Edward J. Craig, of Chile Copper, sailed for Chile on Feb. 7 from New York. He will represent the Anaconda interests in Chile, where he expects to remain for an indefinite period.

W. Val DeCamp, general superintendent of United Verde Copper, at Jerome, has been appointed a member of the Arizona state fair commission by John C. Phillips, Governor of the state.

O. W. Ellis, English metallurgist, now in Pittsburgh, has been appointed to take charge of the metallurgical work now being undertaken by the Ontario Research Foundation.

M. H. Merriss, metallurgical engineer, has become associated with **T. L. Weed** and **Luke H. Rose,** members of the New York Stock Exchange, with offices at 71 Broadway, New York City.

J. W. Whittemore, professor of ceramics at Virginia Polytechnic, will present a paper on the ceramic resources of Virginia at the annual meeting of the American Ceramic Society, in Chicago.

Daniel Williams, formerly in charge of work at the Rocher de Boule copper mine, in British Columbia, is now manager of Hirst Chichagof Mining, on Chichagof Island, Alaska.

C. R. Settlemier, who is interested in several mining properties in the Mayo district, of the Yukon Territory, is at the McAlpin Hotel, New York City. Mr. Settlemier will return to the Yukon in the spring, via San Francisco.

Frederick S. Cook was elected president of the Oregon section of the A.I.M.E. at the recent annual meeting in Portland. Other officers elected include **F. W. Watson,** vice-chairman; and **J. H. Batcheller,** of the school of mines, secretary-treasurer.

W. L. Zeigler, metallurgical engineer, of Hecla Mining, has been elected chairman of the Columbia section of the A.I.M.E. **R. K. Neill,** mining engineer, of Spokane, was elected vice-president, and **L. K. Armstrong,** also of Spokane, secretary-treasurer.

E. D. Foster, mining geologist, of Los Angeles, Calif., has returned from Sonora, Mexico, where he made an extended mineral survey of the La Germania mine between Magdalena and Cucurpe. He reports tranquil conditions and considerable activity in the region.

H. G. Moulton has been appointed a member of the Annual Assay Commission by President Coolidge. The duties of the commission are to review the activities and coinage of the U. S. Mint. Mr. Moulton is a director of the A.I.M.E., which is thus indirectly honored by his appointment.

Robert C. Stanley, president of International Nickel, and **John L. Agnew,** in charge of the Canadian operation of that company, sailed for London from New York last Saturday, in connection with the merger of the International Nickel and Mond companies. They expect to be away several weeks.

OBITUARY

Victor Brandt, of Nevada, died in Los Angeles on Jan. 27. He at one time resided at Hot Creek, Nev., and was interested in mines. With his associates Mr. Brandt owned mining claims at Tybo, subsequently acquired by Treadwell Yukon. He was active in potash investigations and had holdings in various non-metallic mining enterprises.

L. C. Dillman, of Oakland, Calif., formerly of Spokane and Seattle, Wash., died in New York on Jan. 30. He was negotiating the sale of the Eastman mine, in the Kennecott district, Alaska, at the time. Mr. Dillman had long been identified with the development of the mining industry in the Northwest and in Alaska.

James Jensen, superintendent of Chontalpan Mining, at the Xitinga mine, near Texca, Guerrero, Mexico, died suddenly of heart failure on Jan. 27. Mr. Jensen was a native of Denmark, but had been resident in Mexico for many years. He was associated with Real del Monte at Pachuca for many years before joining the Chontalpan company.

James E. Beveridge, for many years active in Utah mining, died at the age of 77 years at his Salt Lake home, on Jan. 30, as the result of a fractured skull sustained in a fall on an ice-covered sidewalk. Mr. Beveridge, who during later years gave almost his whole attention to his Alta interests, was an official of the old Wasatch Mines company. When he first went to Utah in 1878, he started work at the old Telegraph mine, at Bingham.

Urban H. Broughton, engineer and financier, died in London on Jan. 30, at the age 71. Mr. Broughton was a graduate of the University of London, and came to the United States in 1887 to engage in mining engineering. He was connected with the Amalgamated Copper interests and was placed in full charge of the management of United Metals Selling, which marketed virtually all the copper produced by those interests. Later he became president of the Virginian Railway and severed most of his connections with mining companies, retaining the position of director with Anaconda Copper and International Smelting, however. He left the United States in 1912 and retired from active business to become interested in politics.

Colonel **C. E. Loose,** Utah mine operator, banker, politician and associate of Senator Reed Smoot in numerous ventures, died at his Provo home on Jan. 28. With his death, there passes one of the best-known and most colorful figures in Utah mining. He was born in Quincy, Ill., Sept. 19, 1853. Early in his childhood, his father died. At the age of seven, with his mother, who was a convert to the Mormon Church, he made the trip across the plains. When only fifteen years old he went to Eureka, Nev., to engage in mining. Colonel Loose, who received his title as the result of an appointment to Governor William H. Spry's staff, operated the Grand Central, Iron King, Sioux Utah Consolidated, and old Ajax mines in the Tintic district and built up a considerable fortune. At the time of his death, he had withdrawn from active mining.

Thomas Hoatson, vice-president of Calumet & Arizona Mining and New Cornelia Copper, died in Phoenix, Ariz., on Feb. 1, at the age of 68. His death was caused by heart failure, although he had been ill for a long time. Mr. Hoatson was born in Canada and went to Michigan with his parents in 1872. His father, the late Thomas Hoatson, Sr., was superintendent of Calumet & Hecla, and he himself worked for that company for many years. In 1900, Mr. Hoatson first went to Arizona, where he was instrumental in the formation of the Calumet & Arizona Mining Company, in the Bisbee district. He had been affiliated with the Calumet & Arizona organization and its subsidiaries, New Cornelia and Verde Central, ever since then. In addition, he was interested in Keweenaw Copper and Hancock Consolidated, mining companies in the Michigan copper district, and was president of the Merchants & Miners Bank, of Calumet, Mich. Because of his poor health, Mr. Hoatson spent his winters in Phoenix and his summers in Calumet. The funeral was held in Phoenix on Feb. 5, after which the remains were placed in a vault. They will be taken to Calumet for interment in the spring. Mr. Hoatson is survived by his wife and six children, one of whom is Chester Hoatson, vice-president and manager of Belmont Copper.

NEWS OF THE WEEK

Summary

CONSTRUCTION work at Mount Isa Mines, in western Queensland, Australia, is proceeding rapidly, with the object of starting productive operations by the end of the year. Plans for mine, mill, and smelter have been prepared. Page 253.

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The bill proposing to have certain features of the War Minerals Relief Act reviewed by the Supreme Court of the District of Columbia passed the House on Feb. 4, despite objections of Bureau of the Budget. Page 251.

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Merger of Village Deep and City Deep, the two deepest mines on the Rand, in South Africa, is being advocated as costs mount because of the difficulties of mining at depth. Page 254.

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Noranda, Nichols, and British Metals have applied for permission to form a new company to construct a copper refinery in eastern Canada. Page 251.

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A report has been issued by the Attorney-General's Department, in Toronto, Ontario, severely criticizing the management of the Jackson-Manion mine. Page 255.

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Consolidated Mining & Smelting has placed an order for mercury-vapor rectifying equipment for its Trail, B. C., plant that will be the largest installation of its kind for electrolytic work in the world. Page 254.

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An increase of 25c. in miners' wages daily has been announced by most of the important copper companies in Montana and Arizona. Utah and Nevada operators are also increasing wages. Page 250.

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Improvements in the Eagle-Picher Lead smelting and fabricating plants in the Tri-State district are being made which will cost $250,000. Page 251.

Developments Indicate Northern Rhodesia May Be a Second Arizona

Summary of Results Obtained in Exploration to Date Shows Large Number of Possibilities Scattered Over Good-Sized Area—Roan Antelope Will Probably Be First of New Mines to Produce

By George L. Walker
Special London Correspondent

IN MINING circles in London, the opinion is heard every day that the most important new mining field for several years to come will be the copper district in Northern Rhodesia. Though more attention has been given the developments in that field by *Engineering and Mining Journal* than by most other mining publications, they have recently been so numerous, and public interest has been so thoroughly awakened, that a summing up of the present situation seems appropriate. Emphasis should be given to the fact that it is not merely the makings of one or two big mines that have been found, but a new copper region that may some day assume the position in the world's copper production now occupied by Arizona.

Roan Antelope Copper Mines, Ltd., some time ago located ore by trenching in the extension area which it holds on option. A prospecting shaft was sunk, and from the 55 level of this a crosscut revealed 57 ft. of ore averaging 3.86 per cent copper, of which 29 ft. ran 6 per cent. This opening is 5¼ miles from the southeast end of the deposit, and every opening and drillhole between has disclosed commercial ore. Six months ago Roan Antelope was judged to have proved 30,000,000 tons of sulphide ore averaging better than 3¼ per cent copper. A new statement revising the tonnage upward will be issued soon.

Roan Antelope is already connected by branch with the main-line railroad. Erection of a 5,000-ton flotation concentrator, and also a smelter to handle the concentrates, is already being started. The mine is being developed and equipped to supply this tonnage. These plans may be expanded to provide for the treatment of 10,000 tons daily very soon, as the discovery of additional ore has necessitated enlargement of facilities and equipment.

Bwana M'Kubwa has started drilling to test the sulphides below its deposit of oxide ore at the Bwana mine, which was the first important producer in Northern Rhodesia. The first hole entered the upper bed of ore at 250 ft. and passed out of the lowest one at 569 ft., having cut in three beds 63 ft., averaging 3.96 per cent copper. Another hole is being drilled to cut the formation 250 ft. deeper.

The number of diamond drills working at Bwana M'Kubwa's N'Kana property has been increased, and reports of the results of new holes completed are being received every few days. Some of the most recent follow: Hole 18, from a depth of 2,171 ft. to 2,206½ ft., 4.4 per cent copper; drill still in ore. Hole 27 entered ore at 480½ ft., next 20 ft., averaging 3.71 per cent. Hole 25 reached the bed at 741 ft. and cut 28 ft. (true width), averaging 4.44 per cent.

Of all the holes drilled at N'Kana, only two have failed to find ore of good grade and width. No. 21, completed several months ago, cut no commercial material. Recently one called Random Hole A, located 13,000 ft. south of the area previously drilled, entered the mineralized zone at 264 ft., continuing in it to a depth of 317 ft., the bottom 6 ft. averaging 3.21 per cent. That above apparently was not of commercial grade. As no sludge was obtained, and as the recovery of core was very low, this hole evidently struck a place where the ore had been badly leached.

Prior to a month ago, drilling at N'Kana had outlined 24,106,000 tons of ore averaging 4.2 per cent copper, of which 19,936,000 tons was sulphide. This ore is largely bornite and chalcopyrite. As the geological basin at N'Kana containing the mineralized formation appears to be large enough to contain 2,000,000,000 tons of ore, the remarkable persistence of values found in the first square mile or so drilled can hardly be expected to continue throughout the entire area.

Bwana M'Kubwa will probably take up the work of developing the N'Kana deposit for mining operations and will soon construct a pilot plant and erect a mill of 5,000 or 10,000 tons' daily capacity. Options given on treasury stock, all of which may now be exercised with profit, will provide the company with more than $7,500,000 of

Open-cut workings of the Bwana mine of Bwana M'Kubwa Copper, the first large copper producer in Northern Rhodesia

new cash capital, to be added to about $2,000,000 already in hand.

N'Changa Copper Mines, Ltd., reports that Borehole B.16—an inclined hole starting from the 300-ft. level of the crosscut from its Main Lode shaft—penetrated ore for 90 ft., indicating a true width of 69 ft., averaging 4.35 per cent copper, and was still in ore. Great width and excellent grade are characteristics of the N'Changa deposit. This hole is made particularly interesting because 98.39 per cent of the copper found in core and sludge was in sulphides.

Though N'Changa has an ore area that quite possibly may contain over 200,000,000 tons, the considerable tonnage heretofore outlined by drilling and underground development is chiefly oxides. The belief that sulphides would replace the oxides when sufficient depth was reached seems to have been proved now, No. B.16 hole having entered the ore at a vertical depth of 550 ft. below the surface.

As the N'Changa orebody apparently averages more than 80 ft. in width and has an average copper content of approximately 4 per cent, its commercial importance was not, of course, dependent on any change of character. Nevertheless, this proof of the existence of sulphides of excellent grade, and presumably in large tonnages at depth, apparently brings the company much nearer large-scale and profitable production.

From about 10s. recently N'Changa stock has advanced to 50s., at this writing. The sharp rise can be accounted for by the fact that only 600,000 shares are issued and the company has no other capital obligations. This is mentioned to make it clear that financing should be accomplished easily. Rhodesian Congo Border owns 225,000 shares of N'Changa; and Minerals Separation, Ltd., and other strong interests have large holdings of it.

The most sensational recent development is that made by Rhodesian Selection Trust, Ltd., in the Mufulira area of the N'Kana Concession. A series of rather unimportant outcrops of copper ore occur and reoccur in line for a distance of 12 miles or more, dipping southwest. Four drillholes, spaced 1,000 to 2,000 ft. apart, over a distance of 5,000 ft., cut an average of 58 ft. of ore, averaging 5.99 per cent copper. Hole No. 3, the one farthest southeast, was a blank. No. 6 also appears to have missed the formation. Drillhole No. 7 cut two beds, the first 12 ft. of 2.83 per cent, and the second 92 ft. of 4.78 per cent copper ore, and No. 8, at the last account, had just entered ore. Mufulira's ore is in the N'Kana-Roan formation, which extends for a distance of 30 or 40 miles. The possibilities of such great extent of this ore deposit, added to its demonstrated width and grade, have caused Rhodesian Selection Trust stock of 5s. par to sell for over 60s. Now the company is issuing 1,000,000 additional shares to holders at par, and the price of 19s.6d. of the rights enables those stockholders so disposed to realize something equivalent to a dividend.

The properties mentioned are so far apart that they hardly can be said to be a group. Standing at Bwana M'Kubwa, one is 20 miles from Roan Antelope, 33 from N'Kana, 65 from N'Changa, and 47 from Mufulira. However, all are in a southeast-northwest belt and each is within 30 miles of the railroad. The entire area between and surrounding these properties has excellent possibilities, and several prospects have been located that are already attracting attention. In one of these, Chambishi (Rhodesian Selection Trust), a drill has revealed 25.7 ft. of 5.9 per cent ore. Another potential mine has been revealed by a drillhole put down by Rhodesian Congo Border to cut the western extension of the N'Changa orebody. It is 820 west of N'Changa's end line and it struck 80 ft. of 3.33 per cent ore, indicating the possible existence of sufficient tonnage to make another mine.

Wages for Copper Miners Advanced 25c. Daily

WAGES of mine, mill, and smelter employees in the principal districts of Montana and Arizona have been increased 25c. a day by the leading copper companies, effective Feb. 1, according to an announcement just received. On Oct. 1, wages were advanced about 50c. daily. The latest increase makes the basic daily wage at the Butte properties of Anaconda Copper $5.50 for miners. To this, of course, bonuses obtainable under the company's system must be added. Arizona wages are about on the same scale. Although details are not available, for the more skilled labor, such as timbermen, the advance was probably proportional. Wages are also being advanced in Nevada and Utah.

This advance probably has resulted from the rise in the copper price above 17c. a pound. The increase in October came when copper went above 15c. a pound, and at that time the companies concerned state that the increase was to continue as long as *Engineering and Mining Journal* quotations remained above 15c. a pound. This retroactive clause has probably also been included in the present advance.

Golconda Expects to Hit Vein on 1,400 Level Soon

CROSSCUTTING from the shaft on the 1,400 level of Golconda Lead, in the Coeur d'Alene district, is proceeding rapidly, and the vein is expected to be cut about Feb. 15. The management expects to encounter the vein about 350 ft. from the shaft, which is sunk from the 1,000 tunnel level of the mine. A large station has been cut on the 1,400 level in preparation for productive operations when the vein is reached. On the 1,200 level, the orebody was longer and wider than on the 1,000 level, and this improvement is expected to continue with depth.

When the Golconda vein is tapped, the crosscut will be continued to the south into the Mayflower ground, recently taken over by the Golconda company. Operations at the mill, which were started this fall, are being conducted on a three-shift basis. From 25 to 30 tons of zinc and lead concentrates are being produced daily.

Tintic Lead Now Employing 50 Men at Horn Silver

THE Horn Silver mine, operated by Tintic Lead company, is being reopened near Frisco, Utah, under the direction of Manager A. E. Kipps. Fifty men are now employed. A new bunkhouse, capable of accommodating 33 men, is being completed. The surface plant, consisting of shafthouse, hoist, and compressor, timber framing, machine shop, and blacksmith departments, has been rehabilitated, and an assay office equipped. Work of cleaning the three compartment 1,600-ft. shaft has been completed to a point near the 700 level.

House Passes Bill Granting Courts Power on War Minerals Relief

By Paul Wooton

Special Washington Correspondent

DESPITE notice from the Bureau of the Budget that the bill proposing to have certain features of the War Minerals Relief Act reviewed by the Supreme Court of the District of Columbia is in conflict with the financial program of the President, the Committee on Mines and Mining has reported the measure to the House, which approved it, 197 to 72, on Monday morning, Feb. 4.

Chairman Robsion, of Kentucky, in his report on the action of the committee, points out that the bill does not increase the scope of the War Minerals Relief Act and does not permit of the filing of new claims. It simply confers upon the Supreme Court of the District of Columbia, and courts above, the right to pass upon the questions of law involved in the interpretation of the act by the Secretary of the Interior, particularly the ruling in which he denies refunds of money expended for the purchase of property and for money which was paid out for interest on borrowed capital used in the production of minerals during the war. Mr. Robsion estimates that should the courts decide that the Secretary of the Interior is wrong in denying payments for those two items it would mean an additional expenditure of not more than $3,000,000. It is admitted that there are some other questions of law involved which would require the payment of several millions of dollars more, but the committee is convinced that there can be little doubt of the correctness of the interpretation made of the law by the Secretary in those particulars.

Congress originally appropriated $8,500,000 for the relief of those who undertook to produce certain minerals urgently needed for the conduct of the war. All of that amount has been awarded or used for administrative expenses except $962,406.

Unless this measure becomes law, Mr. Robsion warns that it will mean that a large number of individual claims will be brought before Congress in separate bills. He believes it would be very much better to have test cases brought in the courts and have the matter settled once for all.

The bill proposing that $150,000 be authorized for research work dealing with the recovery of potash from leucite, alunite and other potash-bearing minerals has been reported favorably by the Committee on Mines and Mining of the Senate. The bill, which provides for the conduct of the research work by the Department of Commerce, passed the House on May 21, 1928.

Miami Copper Improving Hoist and Power Equipment

MIAMI COPPER is making extensive improvements of its hoisting equipment and power plant at Miami, Ariz. The present motor for the ore hoist will be replaced by a 1,400-hp. d.c. motor with semi-automatic control. That is, the motor will be started by means of a push button at the ore pocket, which the skiptender will push after he has filled the skip. This type of control is the same as that used at Inspiration Consolidated. The present motor-generator will be replaced by a 1,000-kw. induction motor-generator set which will have a 50,000-lb. flywheel. Supplementary equipment includes thirteen electrically operated Type B-32 oil circuit breakers, controlling thirteen circuits, two of which are 1,600 amp., four 800 amp., and seven 600 amp. All equipment will be assembled as far as possible at the factory and will be installed with very little interruption of production. Miami Copper hoists ore through No. 5 shaft only, so the change must be made as quickly as possible.

At the power plant, capacity is to be increased by the erection of four new boilers of 720 hp. each, which will operate at 400-lb. steam pressure. This power will be used to drive a new 15,000-hp. turbine generator. Installation will probably be completed by the end of March. At present all electric power is obtained from two 4,000-kw. turbine generators, which have been insufficient for the load since the first of the year. Up to that time power for the ore hoist was obtained from the Roosevelt dam, but the low stage of the water in the reservoir made necessary the shutting off of power from that source.

Calumet & Hecla No. 17 Shaft Producing 500 Tons Daily

CALUMET & HECLA'S No. 17 shaft, on the Osceola lode, in the Michigan copper district, is now producing about 500 tons of ore daily. Two shifts are being worked for mining purposes, and a third shift is engaged in shaft and skip road repairs. The No. 17 shaft is the last unit to be opened in the Osceola department. In the company's No. 4 Calumet shaft, rich ore is being reclaimed from backs of old stopes and arches as new levels are opened through the fire-damaged section in the upper part of the mine. The shaft burned several years ago from the 56 to 78 level and operations will probably not be resumed between these levels, as they were pretty nearly exhausted. Below the 78 level, ore is hoisted to the main haulage tunnel and then through the Red Jacket shaft.

Copper Refinery Planned for Eastern Canada

APPLICATION for incorporation of a new company, which will construct a customs copper refinery in eastern Canada, has been made by Noranda Mines, Ltd., according to J. V. Murdock, president of the company. Investigations are being made to determine when and where the refinery will be built. Associated with Noranda are British Metals Corporation, which now has a contract to dispose of production from the Noranda smelter, in the Rouyn district, and Nichols Copper, which is engaged in building a new refinery at El Paso, Tex., in association with Phelps Dodge, Calumet & Arizona, and New Cornelia.

This is the third announcement of a new copper refinery in North America to come within the last year. The joining of the three Arizona copper producers with Nichols to build a plant with a 100,000-ton yearly capacity at El Paso was made known last May. More recently Consolidated Mining & Smelting has announced its readiness to build a copper refinery, as well as smelter, on the British Columbia coast, provided the other copper producers in British Columbia agree to furnish blister copper for it.

A copper refinery in eastern Canada would have as its main potential sources of supply, in addition to Noranda, the copper output of the International Nickel Company, from its Sudbury properties, and possibly the blister copper from the new Flin Flon smelter.

Eagle-Picher to Remodel Tri-State Lead Plants

By Telegraph to "Engineering and Mining Journal"

JOPLIN, Mo., Feb. 6, 1929—Improvements to the Galena, Kan., and Joplin, Mo., plants of the Eagle-Picher Lead Company, to cost $250,000, have been approved and will be made immediately, according to an announcement by John A. Schaeffer, vice-president of the company. The Galena plant, 6 miles west of Joplin, will be modernized and doubled in capacity, and when completed will be the central pig-lead producing plant of the company. A Dwight & Lloyd sintering machine and refining equipment, housed in a new building, on acreage purchased adjoining the company's present smelter, will be included in the improvements. As a result of these changes the company can treat complex ores from its Arizona mine.

A sheet-lead rolling mill will be added to the Smelter Hill plant at Joplin, which will become an exclusive fabricating plant for the company. Completion of the sheet mill will make the Smelter Hill plant one of the most complete lead-fabricating plants in the United States, capable of producing any one of the various lead products. All smelting formerly done at the Smelter Hill plant will be done at Galena.

Silver Reef Shaft Down to 500 Level

THE vertical shaft of Silver Reef Mines, near St. George, southwestern Utah, has reached a depth of 500 ft., and drifting on the Buckeye Reef will be started immediately. This sandstone formation, 70 ft. thick, was one of the main producers of the old camp fifty years ago, and is credited by U. S. Geological Survey reports with an output of 8,000,000 oz. of silver. The ore occurred in a sandstone, often associated with carbonized vegetal remains, where conditions for precipitation of the silver-copper minerals were evidently favorable. Silver, also found in a sandy matrix containing lenses of clay shale, was apparently present in both sandstone and clay.

None of the Buckeye Reef producers were worked deeper than 1,000 ft. on the incline or about 150 ft. vertically below the surface. Normal dip of the Buckeye Reef, 25 deg. to the west, has flattened to 5 deg., according to A. H. Means, manager of the western department of American Smelting & Refining, which now controls the property. Drifting will be done in two members of the Buckeye Reef—the Tecumseh, near the top, and the Buckeye, at the bottom. Rails and pipe sufficient for 4,000 ft. of work have been ordered. Water developed, amounting to only 20 g.p.m., is being handled by a Triplex pump. A pump station and sump has been cut on the 300 level.

F. A. Linforth Elected Chairman of Montana Section

F. A. LINFORTH, geologist and mining engineer, who has been connected with Anaconda Copper Mining at Great Falls and Butte for more than 20 years, was elected chairman of the Montana section of the A.I.M.E. at its annual meeting. Mr. Linforth will also represent the Montana section at the annual meeting in New York. Other officers elected include P. F. Beaudin, general manager, East Butte Copper, vice-chairman; Alexander M. McDonald, mining engineer, rock drill equipment department, Anaconda Copper, secretary-treasurer; and R. B. Caples, of the Great Falls zinc plant, Anaconda Copper, and J. D. McKenzie, manager of the East Helena smelter, American Smelting & Refining, executive committee.

At the meeting E. R. Borcherdt read a paper on the Hawkesworth drill bit and its use by Anaconda Copper. He said that this drill bit had been found more economical than the old forms of drilling steel and that Anaconda was installing the Hawkesworth bits in all its Butte mines. Mr. Linforth read a paper on "Stope Sampling in the Butte Mines." In this paper he showed how, through sectional sampling, the average grade of ore extracted had been raised to more than 80 lb. of copper per ton, and mining costs had been lowered.

Ownership of Blue Bird Mine Is Disputed

SUIT has been filed by Silver Leaf Metals, Inc., of Denver, Colo., to prevent Buckeye Mines & Milling from declaring void the contract whereby Silver Leaf acquired the Blue Bird mine, in the Cripple Creek district, and from taking over the property. Silver Leaf entered into an agreement with Buckeye, which owned the Blue Bird mine, to purchase it for $250,000, which was to be paid over a period of three years, and was to be obtained from mine production. The company had paid $64,000, but failed to meet its obligation in September, 1928. Buckeye demanded that the payment be made by December, and when the obligation was not met at that time, threatened to take over the property.

New Crushing Equipment Installed by Utah Copper

THIRTY 7x10-ft. ball mills, each with a capacity of 280 tons daily, are being installed at the Magna and Arthur mills of the Utah Copper Company near Salt Lake City, Utah. A Symons cone crusher has been installed at the Magna plant for testing purposes. The ball mills, of Utah Copper design, will supplant old equipment, rather than increase grinding capacity. The change in crushing equipment is dictated by the desire of the company to increase its recoveries by using high speed, fine grinding and at the same time effect a power saving.

Bingham Prospect Shipping Carload of Ore Daily

BINGHAM Prospect, at the eastern end of the Bingham, Utah, district, adjoining Bingham Mines, has entered the shipping class. Production, totaling about 140 carloads of ore since the discovery last year, is averaging about a carload a day. The property, ownership of which is controlled by J. A. Hogle, of Salt Lake, was opened up by J. J. Beeson, as geologist and manager. Since Mr. Beeson's duties as geologist and general manager for Park City Consolidated have claimed most of his attention, George Stott, formerly of Eureka, Nev., has been appointed superintendent.

The ore is of two grades, carbonate and sulphide. The carbonate ore carries 25 oz. of silver to the ton, 20 per cent lead, and $1.50 to $2 a ton in gold. Sulphide values are not quite as high. Carload shipments net the company, after railroad and smelter deductions, about $1,000 each. Ore occurs as a replacement of the upper Commercial limestone.

Arizona Asbestos Properties Make Many Improvements

FOUR carloads of new machinery have been received by Regal Asbestos at Chrysotile, Ariz. The new equipment includes a blower for mine ventilation, crushing machinery and a compressor. It is expected that mine output can be increased to five tons of asbestos fiber per day when the new machinery has been installed. It has been rumored that Regal is to take over the Crosswaite property in the same district.

Surface structures, including a mess hall, blacksmith shop, tool house and compressor building, have been completed at the Bear Canyon asbestos property, north of Rice. The Bear Canyon company has also constructed a new six-mile road from its property to the Rice-Springerville highway. Frank J. Lunn, of Globe, is manager and Western vice-president. The company is controlled by Dr. R. V. Mattison, of Ambler, Pa. The Arizona Asbestos Association, a subsidiary of Johns-Manville, is producing a carload of asbestos fiber every three weeks at its property at Chrysotile. Frank Knucky is superintendent.

Southwestern to Build 400-Ton Mill for Christmas Copper

CHRISTMAS COPPER is planning the construction of a 400-ton mill at its property at Christmas, Ariz., according to an announcement of F. A. Woodward, vice-president and general manager. Some of the machinery from the Iron Cap mill, at Copper Hill, will be used at the new plant and the remainder of the equipment will be purchased. The mill is to be erected by the Southwestern Engineering Company, of Los Angeles. M. B. Simpson, construction engineer and chief draughtsman, will be in charge of the work.

Shipments of copper ore from the Christmas mine have been sent to the Hayden smelter, of American Smelting & Refining, in the past.

Park Bingham Orders New Haulage Locomotive

PARK BINGHAM has ordered a 5-ton Mancha storage battery locomotive for haulage in its Butterfield tunnel at Bingham, Utah. A 1½-ton Mancha will be used for gathering cars from the various drifts. Ore has been struck in the Bonanza lease of the Park Bingham mine, which adjoins the United States mine, of the U. S. Smelting Refining & Mining, on the tunnel level in the Rough Wrestler fissure. On the 435 and 350 levels above the tunnel, the company is drifting in the "B" limestone for the upward extension of the deposit struck below.

E. R. Pembroke has been elected president and manager to succeed F. E. Porter. Roy Mitchell is in charge of operations at the mine.

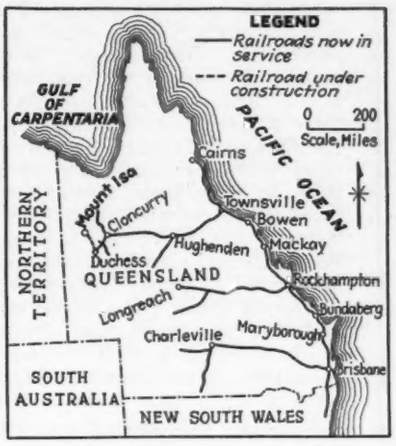
Mount Isa Makes Steady Progress Toward Production by End of 1929

Railroad Within Twelve Miles of the Mine, Dam at Rifle Creek Ready Soon, and Plans for Mining Methods and Metallurgical Plants Prepared—Knox Estimates 21,200,000 Tons of Ore

EVERY effort is being made to complete construction work at Mount Isa Mines, Ltd., in Queensland, Australia, so that operations can be started by the end of 1929, but in any case the mine should be operating early in 1930, according to Russo-Asiatic Consolidated, consulting engineers to Mount Isa. Russo-Asiatic holds a controlling interest in the property. In an interim report from London, on Jan. 16, an estimate of ore reserves is given, prepared by H. H. Knox, mining engineer, as of Nov. 29. He estimates a total of 21,200,000 tons of silver-lead-zinc ores, which he separates as follows: Carbonate ore, averaging 9 per cent lead and carrying 3.6 oz. of silver to the ton, 3,500,000 tons; sulphide ore assured to 750 ft., assaying 6.1 per cent lead, 8.2 per cent zinc, and 3.7 oz. of silver to the ton, 12,200,000 tons; additional sulphide ore, of the same assay, expected above this level, 5,000,000 tons; and, in addition, approximately 500,000 tons of sulphide ore of much higher assay. This estimate is subject to increase from time to time as additional blocks of ore become measurable. Already since the date of Mr. Knox's report, considerable additions have been made to the foregoing amounts.

C. A. Mitke, of Phoenix, Ariz., is now at Mount Isa, engaged in supervising the introduction of the mining methods which he has selected as best suited to the deposit. Mr. Mitke reports that a large amount of carbonate ore can be mined at a low cost by the glory-hole method. For ore not suited to his method, shrinkage stopes will be used. Mr. Mitke anticipates a production of approximately 100 tons per man-shift by shrinkage methods. The average cost of mining, per ton, is estimated at 5s., and for several years the cost of mining the Black Star carbonate ore is expected to be under 2s. a ton, which is cheaper than could be expected from steam-shovel work.

Design and construction of the mill and smelter are under the supervision of J. M. Callow, president of General Engineering, Salt Lake City. Nearly all the orders for machinery have been placed and deliveries are being expedited. The mill is designed for a nominal daily capacity of 1,500 tons, but capable of eventually reaching 2,000 tons. Milling costs are estimated at 5s. per ton. Both zinc and lead concentrates will be made. From results obtained in pilot plant and laboratory tests, recoveries of 91 per cent for carbonate ore, 87 per cent for lead sulphide ore, and 66 per cent for zinc sulphide ore are expected. L. K. Jacobsen, formerly metallurgist for Utah-Apex, is in charge of the tests.



Map of Queensland, showing location of Mount Isa, and railroad now in construction from Duchess to the mines.

The smelter will consist of sintering plant and blast furnaces, with the customary auxiliary apparatus. In both mill and smelter, all handling and transport of material will be done mechanically. Power for mines, mill, and smelter will be furnished by a central power station, for which two 5,000-kilowatt turbo steam sets, with boilers adapted for coal-dust firing, have been ordered.

The dam at Rifle Creek, which is to provide water for operations, will be completed this month. The pipe line from Rifle Creek to Mount Isa, 20 miles in length, is in course of delivery. Rails have been laid on the government railroad from Duchess to Mount Isa to within 12 miles of the mine. The line is expected to be operating through to the mine in April. Provision is also being made for the internal railroad, linking up the mines with the mill and smelter. Profits, under the program now outlined for operations, are estimated at 30s. per ton of ore treated, provided that lead remains at £20 a ton, and silver at 2s. an ounce.

Luiri Gold Crosscutting to Main Reef on 200 Level

Development on the 100 level of the Matala Hill mine of Luiri Gold, in northwestern Northern Rhodesia, has continued satisfactorily and the ore reserves are being added to steadily, according to H. C. Hankins, secretary of the company. On the 200 level, it is not expected that the main crosscut from the shaft will cut the reef for several weeks, but several lenses parallel to the reef have been cut. During the three months ended Dec. 31, 1928, 659 ft. of underground work was done, most of it on the 100 and 200 levels. The usual difficulties in starting a plant composed largely of second-hand equipment have been encountered, Mr. Hankins states, and it has been found necessary to purchase additional machinery. During December the mill ran 130 hours in an experimental way, and 180 tons of ore was treated, and a satisfactory recovery of gold was made.

Germany Prohibits Shaft-Sinking in Potash Mines

THE German government has prolonged until Dec. 31, 1931, the provisions of the law prohibiting shaft sinking in potash mines, believing that no need exists for the exploitation of new seams of potash, according to the U. S. Department of Commerce. The law was to have expired on Dec. 31, 1928.

Under the effects of this law, according to German press reports, intense rationalization has taken place in potash mining. Of the 229 works for which production quotas were set by the Potash Syndicate, 121 works have been closed down permanently. At the end of October, 1921, borings had been made for sinking 64 shafts. Of these only three pits have been completed, and three more are now in course of development. The remaining 58 pits either have been closed or serve for the exploitation of rock salt and other minerals.

St. Joseph Lead Drilling at Sylvia Lake Property

Drilling on the Sylvia Lake property of St. Joseph Lead, in St. Lawrence County, N. Y., is now under way. The property is about 11 miles from the Edwards mine, of the same company, which is now producing about 300 tons of zinc concentrate a week. The New York Central Railroad will build an extension to the Sylvia Lake property, which also carries chiefly zinc ore. It was acquired by the company about three years ago, and, although there is a small shaft, work at present is confined almost entirely to drilling operations.

Mountain View Reopened

According to an announcement recently made by J. R. Hobbins, vice-president of Anaconda Copper, the Mountain View mine of the company, at Butte, has been reopened and will employ 600 men as soon as operations are brought up to capacity. In the last four months, Anaconda has put four of the Butte mines that had been idle for some time back into operation—the Belmont, Original, Mountain View, and Badger State. These mines will give employment to 2,700 men.

Johannesburg Letter

By Owen Letcher
Special Correspondent

Suggest Merging Village and City Deep, on Central Rand, to Cut Mounting Costs

JOHANNESBURG, Jan. 2, 1929.—In some quarters the suggestion is being made that an amalgamation of the Village Deep and City Deep mines, the Rand's two deepest mines, would be a wise step that would result in substantial benefits to shareholders in both companies. The large losses recently incurred by the City Deep through an appreciable drop in grade and shortage of development faces constituted one of the most unsatisfactory features of the Rand mining industry in 1928. In 1927, this mine made a working profit of £120,517, which compared unfavorably with the £397,147 earned in 1926. For the eleven months ended with November of 1928, however, results have been still less satisfactory, the company milling 930,500 tons and registering a working loss of £91,735.

AT THE same time, the Village Deep has been recently recording steady increases in profits. As the Village Deep adjoins the City Deep on the west, consolidation of the two properties is advocated. This should result in cutting working costs, which are high because of the great depth of the operations. As a matter of fact, such a consolidation should have been achieved years ago. It was suggested before the World War, but no action was taken, although the Crown Mines consolidation took place at about that time.

Village Deep has just re-entered the dividend-paying list, but, although the City Deep is losing money, it has a much larger area of commercial ore remaining than the Village, and, with these two counterbalancing factors, it should not be difficult to evolve an equitable basis for consolidation of the two mines.

Under the supervision of W. F. H. Dudgeon and B. G. Byerly, consulting engineer and manager, respectively, of the Waaikraal mine, in the Rustenburg district, steady progress is being made in opening up the property. It has had a somewhat checkered career and has proved a puzzle to several geologists. Gold occurs here in the form of an igneous sill. During preliminary prospecting operations, very high-grade ore was found, but the gold carrier was subsequently lost through extensive faulting. A few thousand tons of rich ore had been blocked out, however, and a short time ago, fresh capital for development was obtained. A small cyanide plant was constructed and development operations were continued.

As a result of the new work, the financial position is now sound, the plant has been paid for and is in operation, and profits are being earned steadily. Boreholes have been drilled north and south of the mine and the continuation of the reef on both sides has been proved. The management has decided to sink additional shafts to obtain conclusive information. On the 155 level of the main shaft, the drift has been continued and results are improving. At a point 60 ft. south of the main shaft, an incline shaft was started which will connect with the drift at a depth of 130 ft.

Consolidated M. & S. Pioneers in Largest Mercury-Vapor Rectifier Installation

CONSOLIDATED MINING & SMELTING COMPANY has placed one of the largest orders for mercury-vapor rectifying equipment that has been negotiated on this continent. The order was secured by Bartholomew, Montgomery & Company, of Vancouver, B. C. The equipment consists of three Brown Boveri mercury-vapor rectifiers each having a capacity of from 10,000 to 12,000 amperes at 500 volts. The power feeding these rectifiers will be taken from the 60,000 volt line at Trail. A Brown Boveri 66,000-volt 1,000,000 kva. interrupting capacity switch will control the power to the 25,000 kva. bank of single-phase transformers, which will step down the pressure to 13,000 volts. Power will be taken at this voltage to three individual 5,000 kva. three-phase step-down transformers, each of which will feed two 5,000 to 6,000 ampere rectifier cylinders which will operate in parallel. The current will be converted from alternating to direct current in the cylinders and then will be taken to the electrolytic cells.

The installation represents the largest application of mercury-vapor rectifiers to electrolytic work anywhere in the world and is the first on this continent. It is probably the largest installation of mercury rectifiers that has been made in any single plant and it constitutes another important step in the general change that has taken place in Europe and is following on this continent, in the substitution of mercury rectifiers for rotary converters. The cost of the installation will be more than $500,000.

A. S. & R. to Make Extensive Improvements at El Paso

AN EXPENDITURE of several hundred thousand dollars will be made by American Smelting & Refining in improving its smelter at El Paso, Tex., during the year, according to Brent N. Rickard, manager of the plant. The construction program includes the erection of a large Cottrell plant to eliminate the smoke nuisance from the works, the rebuilding of a copper-smelting reverberatory furnace, the building of a new reverberatory furnace for the treatment of copper-bearing dross, and various improvements in the ore-sampling department. Plans for the Cottrell plant are now being prepared. Construction is scheduled to start in April, and the plant should be completed about Sept. 1. The capacity of the Cottrell plant will be about 400,000 cu.ft. of gas per minute.

Rebuilding of the copper-smelting reverberatory furnace will be completed about April 1. The furnace will smelt about 600 tons a day, bringing the daily copper smelting capacity of the works to 1,600 tons.

Mineral Land Bills Receive Approval in Congress

THE House of Representatives at Washington has passed a bill authorizing patents to 320 acres of land containing at depth copper, lead, zinc, gold, silver, and associated minerals, without the locator showing a mineral discovery, but requiring compliance with other provisions of the lode mining laws. The committee had recommended 640-acre patents, but the amount was cut in half on motion of Representative Yon, of Florida. Representative Douglas, of Arizona, and Arentz, of Nevada, explained the bill.

The Senate has passed a bill providing that mining locations in the Black Hills and Harney National Forests shall only confer the right to remove the minerals, and restricting the occupancy of the land to prospecting and mining, with no right to take other resources or to hold title to the surface. Senator Norbeck, of South Dakota, stated that the purpose is to forbid the fraudulent practice of acquiring forest lands by filing mining claims where there is a show of color but where the land is not really mining property.

Magma Strikes New Ore on 2,550 Level

Magma Copper has struck a new orebody of 4 per cent copper ore on the 2,550 level of its mine at Superior, Ariz. The ore is southwest of the No. 5 shaft and west of the present producing area. Where cut, the vein was more than 15 ft. wide, of which 11 ft. averaged 4.25 per cent copper and 2.15 oz. of silver to the ton. Another crosscut has been started to this vein.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Ontario Government Issues Report of Investigation of Jackson-Manion

TORONTO, Feb. 2, 1929—The Attorney General's Department of Ontario has been continuing its investigations under the Security Frauds Prevention Act. The latest mining company to come into the limelight is the Jackson-Manion, of the Patricia district, regarding which a lengthy report has been issued, severely criticising the management of affairs and alleging misrepresentation of the facts. The report states that undoubtedly both Harcourt, who was the managing director, and Thomson, the mine manager, misrepresented the facts. Neither of them made or caused to be made proper assay plans and Harcourt apparently made no check up whatever of the reports made to him by his manager, although he was an engineer himself and although he had all the information and data for the purpose. Harcourt was also a member of the financing syndicate which had sold to the public about 550,000 shares of stock.

HIS final report in the middle of October stated that representative channel assays showed high-grade ore over stoping widths and that a conservative estimate of the average grade of ore drifted through to date would be over $12 a ton. Just prior to giving out this report Harcourt, who was also a broker, had caused an additional distribution of 150,000 shares. Reasons are said to have existed for him to conceal and distort the facts which stood out plainly from the real assay sheets and to improve upon the pictures which had been presented to him by the mine manager, with an intent to conceal the true facts from the directors and the public. Three engineers who had also at various times made examinations of the property and who were responsible for giving out the true facts of the case, which led to precipitate decline in the stock, were also severely criticised in the report on account of their dealings in the shares. There is a feeling on the part of professional men generally that the Attorney General's Department went too far in this matter. A report of this nature made by the government criticising their actions leaves no recourse except to reply through the public press, which is not a satisfactory remedy. A great many people are not prepared to believe that this province has reached the point where reputations may be blemished by the government, outside the courts. As a result of the report, Harcourt and Thomson have been arrested and are now out on bail.

As development work on the Frood mine of the nickel companies in the Sudbury district progresses it continues to give remarkable results. On the 2,800 level of the International Frood shaft the crosscut has passed through 140 ft. of ore on which the assays taken to date indicate an average of more than 20 per cent combined nickel and copper. In addition to this the precious metal content is known to be high, particularly in the platinum metals group. The new plant of International Nickel is expected to turn out 4,000,000 oz. of silver a year, making it the second largest silver producer in Canada, being exceeded only by the Sullivan mine of Consolidated Mining & Smelting. Contracts for the installation of the new smelter and concentrator are being rushed. Part of this plant is expected to be ready for operation about the middle of the year.

Consolidated Mining & Smelting in a quieter way has been emulating the performance of International Nickel and during the last week has risen from $390 a share to a high of $575. Engineers of this company are now visiting Europe to study plants for the fixation of atmospheric nitrogen and the company is proposing to go into the fertilizer business. "Smelters" has been extremely active in developing prospects, particularly in the western and middle western sections of Canada. This company now has its own fleet of airplanes in use for properties distant from other transportation facilities.

Mining Corporation of Cobalt has purchased a 35 per cent interest in the Monarch properties near Field, B. C. The remaining 65 per cent is held by Goldfield Consolidated Mining & Exploration of Nevada. A company with a capital of 3,000,000 shares is being organized to operate this property; 2,000,000 shares will be issued, of which Mining Corporation will hold 700,000 and Goldfield Consolidated, 1,300,000. The ore occurs as a replacement in the limestone and three known orebodies have been developed containing 300,000 tons of silver-lead-zinc ore. A 300-ton mill will be built. Costs are estimated at $3 a ton.

Lena Goldfields Using Airplane Service

IN OPERATING its gold properties in the basin of the Lena River and its tributary, the Vitima, in Russia, Lena Goldfields is making use of the Soviet air service. The fields are situated in a remote district, almost 1,200 miles from any railroads, and all communications with other parts of the Soviet Union previously had to be maintained by way of the Lena River from June to September and by sleighs during the winter months. This year, however, an air service has been started to connect the cities of Irkutsk and Yakutsk, with a stop-over at Bodaibo, the central point of the gold region.

Mexico City Letter

BY W. L. VAIL
Special Correspondent

Legislation Hampering Mine Development in Mexico, Garcia Declares

MEXICO CITY, Jan. 26, 1929.—As most of the present production of Mexican mines comes from the older properties, which are rapidly being exhausted, and as practically no new deposits of importance are being brought to the producing stage, Genaro Garcia, president of the Mexican Mining Chamber, believes that the future of the industry is not particularly bright. Mr. Garcia believes that these conditions result from recent legislation on mining matters and from lack of initiative in encouraging exploration. Mining corporations in one year paid 4,000,000 pesos as a result of the federal 10 per cent addition to railroad freight rates, he declares. As a result of this increase in the cost of transportation, exhaustion of orebodies, high taxes, and low metal prices, an unusually large number of properties are making formal requests for permission to suspend activities.

SINCE the let-down in the oil industry, mining has been the outstanding source of revenue in the republic. In 1927, the government received 66,000,000 pesos in direct revenues from mining companies. The railways hauled 4,500,000 tons of ores, concentrates, or bullion—practically one-third of their entire freight. Mr. Garcia believes that the government should provide facilities which would encourage the exploration of new territory and the opening up of new producers in the now isolated districts of Guerrero, Michoacan, and Oaxaca, where rich ores are known to exist. During the World War, high prices for metals and a large demand encouraged heavy investments in the Mexican mining industry. Many of the larger companies continue operations, even under adverse circumstances, rather than break up their organizations. For these reasons, according to Mr. Garcia, the output has continued large, but the production statistics do not tell the real story. Many mines are rapidly being exhausted and the industry is being confronted with a situation similar to that which overtook petroleum.

Real del Monte, of Pachuca, has moved a steam drill to Guanajuato, and has begun work on the southeast end of the Mona claim on the Mother Lode. The Mona adjoins the old bonanza property of La Sirena. Definite results are anticipated within six months. Other reports from Guanajuato are to the effect that United Eastern has overcome some of the difficulties encountered in its endeavors to work old tailing dumps and is now proceeding steadily with the work.

MARKET AND FINANCIAL NEWS

13 Per Cent Increase in 1928 World Copper Output Indicated

THE production of refined copper in North and South America in 1928 was 1,627,849 tons, compared with 1,477,322 tons in 1927, representing an increase of about 10 per cent. Data have been received from nearly all of the remaining countries of the world from which the A.B.M.S. reckons the production of refined copper in the world in 1928 as 1,954,021 tons, compared with 1,755,068 tons in 1927, an increase of about 11 per cent. In 1927 the refineries in North and South America produced about 84 per cent of the world's total; in 1928 this proportion was reduced to about 83 per cent.

The large increase in the production in Europe was ascribable to the operation of the new refinery at Oolen, in Belgium.

Production of refined copper, in short tons, was distributed as follows:

	1927	1928
Americas, North and South	1,477,322	1,627,849
Germany	114,749	113,244
Other Europe	69,167	116,859
Japan	69,872	72,796
Australia	10,712	10,250
Africa	13,246	13,023
Totals	1,755,068	1,954,021

Production of copper in the form of blister, and its equivalent, in 1928, was about 1,916,000 tons, compared with 1,694,000 in 1927, an increase of 13 per cent. Relatively little secondary copper is included in the production of blister, and consequently the statistics in respect of the latter are the closest reflection of virgin production.

Survey of World Tin Situation

By International Metal Service, London

OUR preliminary estimate of tin production for 1928 is as follows:

	Long Tons	
Federated Malay States	56,600	
Unfederated Malaya	2,500	
Great Britain	2,400	
India-Burma	2,200	
Australia	2,900	
Nigeria	9,100	
South & East Africa	2,600	
Total British Empire		78,300
Bolivia	40,200	
Netherlands Indies	36,600	
Siam	7,900	
China	6,400	
Other Countries	3,800	
Total outside British Empire		94,900
Total world production		173,200

The fourth quarter of 1928 was not responsible for the greater part of the greatly increased production, as the output in the third quarter turned out to be larger than was expected.

According to present information, world consumption of tin in 1928 amounted to within 100 tons of 160,000 long tons. World stocks on Jan. 1, 1929, we calculate at 28,800 tons, or an increase of roughly 13,000 tons on the year. Of these stocks, over 5,000 tons are held by the "bull" syndicate.

If corroboration be wanted for our plea of an association of producers, surely it is supplied by the present statistics. Anyway, the position cannot be allowed to drift indefinitely: the longer the existing *laissez-faire* policy continues, the more dangerous the situation becomes.

As matters are at the moment, the "bull" group will need to go on lifting around 1,500 tons of tin a month in order to hold the market above £220. Substantially greater purchases would be required to inspire an advance. Neither does it follow that higher prices are desirable in prevailing circumstances. For example, consumption of tin during the first half of this year promises to eclipse all previous records for any six months: hence everything should be done to foster consumption, and a continuance of the existing price level would serve this purpose. Secondly, higher prices would further stimulate output, and that is highly undesirable at this juncture. As it is, the F.M.S. production is shaping for a further increase of at least 6,000 tons in 1929, this enhancement being only subject to diminution in the output from native-owned properties.

At the moment, consumptive business is rather quiet, a remark which applies equally on both sides of the Atlantic. But according to all reports the tin plate trade in the United States is now operating at something between 85 per cent and 90 per cent of capacity and the automobile industry is also actively engaged. Hence it is by no means improbable that there will be a better trade demand in the United States ere long. Just now, however, such interest as is evinced is confined mainly to professional operators, and for the past few days the market has worn a somewhat flat appearance, with day-to-day fluctuations on a very minor scale.

New Investment Trust Announced

FORMATION of a new investment trust in the mining and smelting industry is announced by the North American Mining & Smelting Corporation, which is offering 500,000 shares of its no par value capital stock at $3 a share. The corporation is controlled by the Associated Metals Corporation of New York, all of whose issued stock is to be deposited with the Corporation Trust Company of New York under voting trust agreement to be administered by Richard W. Saunders, comptroller of Famous Players-Lasky Corporation, New York; Walter Gordon Clark, consulting engineer, Los Angeles, and Charles E. Krebs, consulting engineer, Charleston, W. Va.

The North American Mining & Smelting Corporation will have a capitalization of 7,500,000 shares of no par value stock and $975,000 of debentures. It will control properties located in Montana, Idaho, Washington, Oregon, California, New Mexico, Arizona, Colorado, Wyoming and British Columbia. Andrew Stevenson, founder and first president of the Bank of Alaska, will be president of the corporation. Associated with him on the board of directors will be Frank C. Jordan, Secretary of State, California; Walter Gordon Clark, consulting engineer; Hugo C. Lambach, mining capitalist; Louis Cruickshank, attorney; Glenville A. Collins, president of Collins Western Corporation, N. E. McCall, and E. Marshall Young.

Britannia Mining & Smelting Company, Howe Sound subsidiary, estimates its production for 1928 as follows: Copper, 41,500,000 lbs.; silver, 202,000 oz.; gold, 15,000 oz.; iron pyrites, containing 49 per cent sulphur, 70,000 tons. The chief change in operations during 1928 was the substituting of outside ore transportation by transportation entirely through tunnels and raises from mine to mill. This entailed moving the primary crushing plant and handling run-of-mine material further down in the system.

Alaska Juneau mined and trammed to mill 302,600 tons of ore in December, 1928, from which the estimated receipts were $231,000, or 76.34c. per ton; operating expenditures, $166,250, or 54.9c. per ton; operating profit, $64,750, or 21.40c. per ton. Other expenditures and accrued charges totaled $16,300, leaving $48,450 to surplus for the month. The year closes with a total estimated operating profit of $1,100,000 and a surplus of $929,050.

London Financial News

By W. A. Doman
Special London Correspondent

London, Jan. 22, 1929—Although interest in Northern Rhodesia copper shares is still keen, market activity has slackened somewhat during the last few days. According to the optimists, it is only in order to take breath preparatory to pushing further ahead. The vast ore reserves that are regarded as available, if not actually proved, are having an effect similar to those of the Frood mine on the shares of the Mond Nickel Company. Sir Ernest Oppenheimer and Solly Joel have paid a visit to Northern Rhodesia and have expressed themselves in no uncertain manner as to the outlook for the future. The former predicts that within the next four or five years at least 30,000 native inhabitants of the region will be employed there, together with a proportionate number of whites. This optimism apparently has attracted American capital. I have spoken to an engineer who represents a large American firm, a level-headed man, and he is just as cheerful as the others. Present prices, he says, do not count; they are nothing to what will rule a few years hence. A rumor has been circulated that Sir Edmund Davis is forming a syndicate to acquire Sir Abe Bailey's interests in the sub-continent. Sir Abe, it is announced, is disposing of his holdings, and devoting himself to racing. On being asked yesterday whether there was any foundation for the story, Sir Edmund stated that he knew nothing about it.

As indicating the close connection that now exists between London and New York, the fact that application is being made to list Malayan Tin on the New York Curb Exchange is of interest.

A short time ago I mentioned a report that J. P. B. Webster, of the Russo-Asiatic, was on the Continent endeavoring to negotiate with the Soviet authorities for the return of the concessions, or, at least, for some equitable manner of dealing with them. Reports from Berlin indicate that the negotiations have reached a critical stage. Owing to the great divergencies of views in connection with pre-war questions, there seems to be little hope of an early settlement.

Duncan Elliott Alves, who is the moving spirit of the Panama Corporation, seems to have made a great step forward. Recently he formed a small syndicate to test and float a part of the Panama property, and it is now announced that he has succeeded in inducing Hugh F. Marriott, the former consulting engineer to the Central Mining & Investment Corporation, to join the board. So far the Panama Corporation does not seem to have made much headway in the affections of the public here, but Hugh Marriott's association may alter this, as he is not likely to form a connection with any enterprise that he has not first checked and found to be promising.

Chemical & Metallurgical Corporation has, it is said, got its sulphuric acid, hydrochloric acid, and platinum plants at work at Runcorn, on the Manchester Ship Canal, and the lead plant is expected to be in commission next month. To finance the business 2,000,000 shares of 2s. each have been sold to Johannesburg Consolidated Investment, Consolidated Gold Fields of South Africa, Camp Bird, and Imperial & Foreign Corporation, at a premium of 1s. 6d. per share.

A rumor has just reached us that De Beers is to acquire Consolidated Diamond Mines of South West Africa on the basis of one share of De Beers for eight Consolidated Diamond company shares.

The diamond position in South Africa is still in a very disturbed state. Unemployed diggers in Namaqualand are threatening to take the position into their own hands unless the government declare some free ground. At the recent annual meeting of the Johannesburg Consolidated Investment Company, Solly Joel expressed the view that the position was well in hand. A few "Thomases" on this side are still skeptical, and suggest he could have been more emphatic. Possibly he was able to express himself so confidently because he has the knowledge that the Union government is behind the industry, and for its own sake dare not allow it to get out of hand. Even the inceptive cutting industry is having its troubles, and there is more than one smug smile over the strike.

A cablegram from Johannesburg states that deposits of nitrates have been discovered in the Mariental district of South West Africa. The consumption of Chilean nitrate is steadily growing, owing to its price having come more into line with other nitrogenous products, and also, say Aikman (London), Ltd., to a growing appreciation of its unequaled qualities. Eventually it is hoped the way will be paved to an international agreement on nitrogen prices.

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Burma Corporation, Ltd., reports that at its recent annual meeting the chairman of the board, in his address, mentioned that the total value of production for the final year under review declined as the result of lower metal prices. The decline in revenue amounted to about £695,000, but increased tonnage, higher grade of ore treated, and improved metallurgy had enabled the dividend rate to be maintained, and the future outlook justified the declaration of a bonus. Depreciation charge against profits at the present time is large, and this condition will continue for another year, after which necessity for writing off would rapidly decline and in a few years be negligible, thus releasing additional profits. The Bawdwin mine has several million tons of additional low-grade ore in reserve, and investigations as to a suitable method of treatment are being undertaken, which, if successful, would materially add to the life of the property.

Hollinger Output Showed Large Decline in 1928

THE value of the Hollinger Consolidated Gold Mines, Ltd., production for 1928 is estimated at $10,800,000, recovered from 1,803,000 tons of ore giving an average grade of $6 per ton. This is a reduction of $3,750,000 in production value, compared with 1927. Operating profits are estimated at $3,200,000, or less than half those of 1927. Dividends paid amounted to $5,412,000 and operating profits, together with other revenue, will lack about $1,700,000 of meeting that figure. The dividend, however, was cut in half last year, and the company is now understood to be earning the reduced rate of dividend by a comfortable margin.

Results for the last quarter of 1928 show an improvement over those for the previous quarter. Grade of ore treated in December was about $7.50 a ton, although it is doubtful if this grade can be maintained. According to an official statement a substantial drop in ore reserves is again to be expected when the annual report is published. Costs for 1928 will show an increase over the record for 1927, because of the larger amount of development work done. The company is in a very strong financial position, with approximately $12,000,000 in cash assets.

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North Lily Issues Favorable Report

GROSS receipts of the North Lily Mining Company, operating in the East Tintic district, Utah, for 1928 totaled $1,413,910, from 49,960 dry tons of ore, or $29.30 a ton. Net income was $857,182 and mine operating expense, $364,789, or $7.30 a ton.

Net income amounted to $857,172.28, or $1.07 per share of stock outstanding. This record was made notwithstanding the fact that the company completed the sinking of its shaft to the 900 level, or 1,246 ft. vertically below the surface, and completed, also, a 3,000-ft. tramway. The value of these improvements, however, is indicated by the fact that output increased from 6,658 tons in the first quarter of 1928 to 17,783 tons in the fourth quarter. Gross incomes for the same periods were $164,860 and $560,838 respectively. Income during the last quarter of the year was at an annual rate of $2,250,000, or nearly $3 per share on the 800,000 shares issued. Net assets as of Jan. 1, 1929, amounted to $777,855, including $575,023 in cash.

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McIntyre-Porcupine Mines, Ltd., reports for quarter ended Dec. 31, 1928, a profit of $482,020, after expenses, interest, and taxes, but before depreciation, comparing with $496,049 in the preceding quarter and $463,231 in the December quarter of 1927. For nine months ended Dec. 31, profit totaled $1,412,552 before depreciation, against $1,293,210 in the corresponding period of the preceding year.

Cresson Consolidated Net Earnings Lower; Operating Costs Reduced

CRESSON Consolidated Gold Mining & Milling Company reports the results of operations during the fiscal year ended Aug. 31, 1928, as follows: A total of 106,041 dry tons of ore was shipped, of a gross value of $977,158, averaging $9.21 per ton. The returns, less transportation and treatment, were $568,418, giving the ore a net value of $5.36 per ton. The company received as additional income $12,574—interest on bank deposits, and $44.98 net royalties from 708 tons of ore shipped by lessees, making a grand total of $581,038, with total expenses of $534,245, resulting in a net gain from operations of $46,792. The total cost per ton of ore produced was $5.04. This is a decrease of 46c. per ton from 1927. Operating costs are distributed as follows:

	Per Ton
General expense	$0.003
Taxes	0.07
Insurance	0.114
Salary officers	0.09
Colorado Springs office	0.10
Mining operations (a)	4.613
Dante operations	0.05
Total	$5.04

(a) Includes mine management and engineering.

In extending development work below the Roosevelt drainage tunnel (17th level) the ore value proved substantially lower than indicated when first encountered.

The high cost of prospecting, mining, and pumping from deep levels resulted in a reduction in the company's profits. Completion of the mining operations below the tunnel level in about six months, thereby materially reducing the cost of operation, is anticipated.

Total cash on hand at the close of the fiscal year ended Aug. 31, 1928, was $395,959.

Burma Corporation Shares on New York Market

SECURITIES of the Burma Corporation, Ltd., were recently introduced on the New York market. Arrangements have been made for the issuance of American deposit receipts of the Guaranty Trust Company on ordinary shares.

Shares of the Burma Corporation are traded on the London Stock Exchange. Capitalization consists entirely of common stock of 10 rupees ($3.65) par value, of which 13,541,689 shares are outstanding of an authorized issue of 20,000,000.

In the company's fiscal year ended June 30, 1928, metal sales were $16,165,749 and dividends paid out aggregated $3,831,099. Production consisted of 72,388 tons of lead, 6,954,665 oz. of silver, 1,056 tons of antimonial lead, 12,388 tons of copper matte, and 58,222 tons of 50.5 per cent zinc concentrates. The company owns a fully equipped railway 46 miles long, a hyro-electric power plant, a concentrating mill, and a smelter and refineries.

United Verde Selling Blackbutte Quicksilver

THE United Verde Copper Company, 111 Broadway, is marketing the quicksilver production of the Quicksilver Syndicate, Blackbutte, Ore. Current output of the Blackbutte property is at an annual rate of about 1,000 flasks, which will be doubled in April of this year, when the installation of additional metallurgical equipment is completed.

DOME MINES preliminary production figures for 1928 show a total production of $3,915,000 and net earnings of $1,939,000, more than twice the dividends paid. Recovery and grade were slightly less than in 1927, which was largely offset by a reduction in operating costs amounting to 21c. a ton, costs for 1928 being estimated at $3.852. Cash assets are now approximately $4,986,000, as compared with $4,000,000 at the end of 1927.

Imports and Exports of Ores and Metals in December, 1927 and 1928

Compiled from U. S. Department of Commerce Records

In Pounds, Unless Otherwise Stated

Imports

	December 1927	December 1928
Antimony:		
Ore — Gross weight	600,415	2,138,134
Ore — Antimony content	333,504	1,232,099
Copper		
Ores, copper content	8,973,264	11,083,335
Concentrates, copper content	2,774,467	5,043,681
Regulus, coarse metal, cement copper	104,000	220,000
Imported from:		
Spain	167,809	318,800
Canada	3,227,463	5,453,096
Mexico	2,396,765	3,052,283
Cuba	503,000	1,826,900
Chile	5,359,290	5,349,730
Peru	26,079	13,132
Other countries	171,325	333,075
Unrefined black converter copper in pigs, bars and other forms	38,522,248	46,898,452
Refined copper	3,197,537	23,395,586
Old and clippings for remanufacture	1,482,479	637,759
Composition metal, copper chief value	.....	36,735
Brass, old, for remanufacture	719,505	1,218,170
Lead		
Ore and matte, lead content	4,257,875	6,155,269
Bullion or base bullion	16,871,408	27,264,228
Pigs and bars	43,620	113,440
Babbitt, solder and other forms — Lead content	169,342	211,661
Babbitt, solder and other forms — Gross weight	103,166	97,544
Type metal, antimonial lead — Gross weight	.....	335,982
Type metal, antimonial lead — Lead content	.....	267,160
Manganese, tons:		
Cuba, manganese content	920	33
Other countries, manganese content	30,851	20,762
Pyrites, tons	7,507	16,477
Tin Ore, tons	7	8
Bars, blocks, pigs	8,865,998	11,759,257
Imported from:		
Netherlands	1,176,983	1,528,078
United Kingdom	1,670,761	3,009,244
British Malaya	5,722,677	5,943,803
Netherland East Indies	69,975	.....
Hongkong	100,900	692,515
Australia	67,200	165,192
Other countries	57,502	420,425
Zinc		
Ore, zinc content — Free, less 10 per cent zinc	.....	.....
Ore, zinc content — Dutiable	247,960	521,237
Old	67,196	291

Exports

	December 1927	December 1928
Copper		
Ores, composition, concentrates, unrefined	903,137	1,375,038
Refined copper in ingots and other forms	90,586,826	66,593,157
Exported to:		
Belgium	9,492,652	4,489,813
France	12,523,595	16,363,483
Germany	20,486,425	9,685,698
Italy	6,897,225	12,711,073
Netherlands	12,572,912	1,665,997
Spain	381,457	324,364
Sweden	1,539,248	1,121,931
United Kingdom	18,327,406	16,074,882
Other Europe	6,473,289	471,026
Canada	221,039	3,383,681
British India	224,257	.....
Japan	896,180	.....
Other countries	551,141	301,615
Old and scrap	5,222,382	3,953,840
Pipes and tubes	166,323	208,133
Plates and sheets	245,736	692,360
Rods	5,581,828	4,918,512
Insulated copper wire and cable	1,514,515	1,650,632
Lead		
In pigs, bars, and other forms	21,784,650	24,794,808
From domestic ore	600,112	6,687,310
From foreign ore	21,184,538	18,107,498
Exported to:		
Belgium	.....	224,087
France	784,185	1,302,699
Germany	6,217,634	4,032,622
Netherlands	1,310,913	761,681
Sweden	1,008,271	896,284
United Kingdom	6,743,352	11,816,940
Other Europe	1,625,479	678,238
Brazil	448,368	627,306
Other South America	854,418	217,956
China, Hongkong, Kwantung	281,061	280,283
Japan	2,464,768	3,810,203
Other countries	46,201	146,509
Other lead manufactures	934,298	1,259,712
Zinc		
Ores and concentrates, tons	1,909	256
Dross	515,692	600,276
Cast in slabs, blocks, and pigs	2,104,639	2,660,982
Exported to:		
Belgium	56,000	64,017
France	517,642	1,265,761
Germany	336,037	582,631
Netherlands	175,229	43,261
United Kingdom	168,027	224,033
Other countries	67,200	190,463
Sheets and strips, other forms	594,742	911,477
Dust	272,404	118,378
Other zinc manufactures	173,521	56,115

The Market Report

Copper Advances ¾ Cent—Lead Up a Tenth

New York, Feb. 6, 1929—Price advances for copper, lead, and tin have featured the non-ferrous metal markets of the last week. Zinc is firm, and any well-defined buying movement will undoubtedly bring higher zinc prices.

Copper Skyrockets

Three advances of ¼c. per pound in the price of copper during the last week were needed to satisfy temporarily the seemingly insatiable appetite of consumers. The latest advance, from 17½c. to 17¾c. per pound, delivered Connecticut, took effect today, though sales at the higher level have been virtually non-existent. Fabricators apparently are fearful of a pinch in supplies. The greater part of the demand continues for forward deliveries—May being the favored month this week, though considerable June metal has also been sold. Foreign demand continues at a high rate, though at least one producer has temporarily withdrawn from this market in order to continue taking his proportion of the domestic business. Sales to domestic consumers in the last week total about 40,000 tons. the largest in any corresponding period since the record sales activity of Christmas week. Copper Exporters, Inc., advanced its c.i.f. price to 17.50c. per pound on Feb. 2, and to 17.75c. yesterday, and a further advance to 18c. will doubtless be announced tomorrow.

Average Metal Prices for January, 1929

COPPER:	
New York Electrolytic	16.603
London Standard Spot	75.551
London Electrolytic Spot	78.602
LEAD:	
New York	6.650
St. Louis	6.498
London Spot	22.111
London Forward	22.344
SILVER:	
New York	57.019
London	26.257
Sterling Exchange	484.577
ZINC:	
St. Louis	6.350
London Spot	26.196
London Forward	26.233
TIN:	
Straits	49.139
London	222.727
QUICKSILVER	119.481
ANTIMONY	9.558
PLATINUM:	
Refined	70.000
Crude	60.000
ALUMINUM 99 Per Cent Plus	24.300

Daily Prices of Metals

Jan. Feb.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
31	16.775	48.50	6.65	6.475@6.50	6.35
1	16.775	48.75	6.65	6.50	6.35
2	17.025	48.875	6.65	6.50	6.35
4	17.025	49.375	6.65	6.50@6.55	6.35
5	17.275	50.375	6.65	6.50@6.55	6.35
6	17.525	49.875	6.75	6.60@6.625	6.35
	17.067	49.292	6.667	6.525	6.35

Average prices for calendar week ending Feb. 2, 1929, are: Copper, 16.817; Straits tin, 48.688; N. Y. lead, 6.650; St. Louis lead, 6.500; zinc, 6.350; and silver, 56.792.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Jan. Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
31	77 7/8	75 5/16	79½	220	221½	22 3/16	22¼	26¼	26¼
1	78½	76⅜	79¾	220¾	221¾	22¼	22⅜	26⅜	26 7/16
4	80½	77⅞	80¾	223	224⅛	22⅜	22 9/16	26 7/16	26⅝
5	80½	78⅛	81	228	228¼	22 7/16	22⅝	26⅜	26 9/16
6	80⅝	77¾	81¾	229½	229½	22 13/16	22¾	26⅜	26 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan. Feb.	Sterling Exchange "Checks"	Silver		Gold London	Feb.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
31	4.84⅜	56⅜	26 3/16	84s11½d	4	4.84½	56⅝	26 3/16	84s11½d
1	4.84½	56½	26 7/16	84s11½d	5	4.84⅜	56½	25 15/16	84s11½d
2	4.84½	56¼	26¼	.....	6	4.84½	56⅝	26	84s11½d

Average, 56.667

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Lead Advanced Ten Points

Increasing prices in London made it possible for domestic producers to advance quotations today without fear of importations of bullion lead, the new levels being 6¼c., New York, and 6⅜c., St. Louis, the first named being the American Smelting & Refining Company's contract price, which also holds for other sellers. Demand has been excellent, chiefly in small lots from a variety of consumers, though corroders and battery manufacturers have shown little interest. Shipment has been well divided between February and March. Producers are oversold as judged by current production and are not at all anxious to sell.

Zinc Firm at 6.35c.

The buying wave which was expected during the last week failed to materialize, though a fair volume of business was done at the unchanged price of 6.35c. per pound, East St. Louis basis.

Tin Spurts Above 50c.

Tin bulls in London succeeded in advancing prices there to £229½ today, but the strong market abroad has induced considerable selling from United States dealers and speculators who bought at lower figures and have been getting impatient, so that yesterday's quotations of above 50c. have been shaded to a fraction below that figure for most of the business done today. January output in the Federated Malay States was 5,840 long tons, compared with the previous high record of 5,500.

Silver Steady

The silver market held steady during the first part of the week, the London price fluctuating between 26⅞ and 26⅝d. and New York between 56⅝ and 56¾c. On Feb. 5 the London market declined sharply ¼d. to 25⅞d., the apparent cause being the semi-official announcement that an agreement had been reached between representatives of the Chinese Nationalists and the Japanese government on the Tsinan-fu incident of May, 1928. The terms of the agreement will not be made public until after approval by Nanking and Tokio, but the expectation of a settlement caused heavy purchases of yen against sales of silver by Chinese speculators. The New York market did not follow this decline.

Mexican Dollars (Old Mexican pesos): Jan. 31st and Feb. 1st and 2nd, 43c.; 4th, 42⅞c.; 5th, 42¾c.; 6th, 42⅞c.

Foreign Exchange

Closing cable quotations on Tuesday, Feb. 5, were: Francs, 3.90⅛c.; lire, 5.23¼c.; and marks, 23.74c. Canadian dollars, ¼ per cent discount.

Price of Lead Concentrates Advanced $2.50 per Ton

Joplin, Mo., Feb. 2, 1929

Blende	Per Ton
High	$43.90
Premium blende, basis 60 per cent zinc	$40.00@ 41.00
Prime Western, basis 60 per cent zinc	39.00@ 40.00
Fines and slimes, 60 per cent zinc	36.00@ 38.00
Average settling price, all zinc	39.66
Galena	
High	$91.10
Basis 80 per cent lead	90.00
Average settling price, all lead	88.75

Shipments for the week: Blende, 13,016; lead, 2,042 tons. Value, all ores the week, $697,370.

Other buyers followed the advance to a $90 basis for lead concentrates set by one buyer last week, and sellers disposed of their current production more freely. Thus far in 1929 production and shipments of zinc concentrates have very nearly balanced, with the balance in favor of the latter by a small margin, so that stocks, reduced to a minimum at the close of last year, are not accumulating.

The selling agency began functioning this week, with a little more than one-third of the total sales made through the agency. From the reading of contracts there is no indication of what producers claim for this plan. It is asserted that the age-old custom of each smelter employing a purchasing agency is to be abandoned and selling is to be done direct to the smelters, on guaranteed assays and weights. It is not expected this change will be wrought immediately, but will gradually become effective. In the meantime the selling agency collects approximately 30c. per ton from each producer whether the ore is sold by the producer or the agency.

Steel Production Close to 90 Per Cent of Capacity

Pittsburgh, Feb. 5, 1929

Steel production in December made a record high for the month, and January brought a seasonal increase over December, ingot production averaging 85 per cent of capacity in December and now being close to 90 per cent. There are expectations of some further increase this month and next, but that would be merely seasonal. The general prospects in steel tonnage for the next few months are not appraised as favorably as a month ago.

Automobile and truck production ended last year rather poorly, so that the year passed the previous record year, 1926, by only 2.2 per cent. January operations have been very spotty, some automobile and parts makers being quite active and others having very light operations, and there is much room for doubt as to the year's total, despite sanguine predictions.

Finished-steel prices are steady but show no buoyancy. Bars, shapes and plates, quoted in December at 1.90c.@2.00c., Pittsburgh, can now be bought in single carloads at 1.90c. if specifications are attractive, but 1.90c. remains minimum on bars in large lots, plates and shapes being susceptible of shading. There is a little shading in black and galvanized sheets. Hot-rolled strips are firm. Cold-rolled strips were advanced on Feb. 1 from 2.85c. to 2.95c., and large rivets from 2.90c. to 3.10c.

Pig Iron—Pig iron has been rather dull in all districts since Jan. 1. Buffalo and Chicago show a little unsteadiness. Valley prices have held: Bessemer, $18@$18.25; basic, $17.50; foundry, $17.50@$18.00.

Connellsville Coke—Spot furnace coke is now quotable at $2.75@$2.85. Spot foundry coke has been steady at $3.75@$4.25, but rather dull.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, quoted at £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, for all positions, 9¾c. Cookson's "C" grade, spot, 14¾c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. Nominal.

BISMUTH—Per lb., in ton lots, $1.70. Smaller lots $1.85 and up. London 7s. 6d.

CADMIUM—Per lb., 85@95c. Active. London, 4s. 2d.@4s. 3d. for Australian metal, early delivery. Forward positions somewhat easier.

COBALT — Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.10@$3, quiet. Black oxide, 70 per cent, $2.10. London, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $3.50.

IRIDIUM—Per oz., $260@$265 for 98@99 per cent sponge and powder. London, £57@£60.

[1]LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $5.

MAGNESIUM—Per lb., in ton lots, single orders for spot metal: 8-lb. ingots (3x3x15 or 16 in.), 85c.@$1.05, depending on quantity; 2½- or 3-lb. sticks (1⅜ in.), $0.90@$1.10, depending on quantity; 10-oz. sticks (1x12 in.), 85@90c. Discounts up to 20 per cent on larger orders or contracts. Market firm. London 3s. 3d.@3s. 6d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per lb. in 1- to 3-lb. lots, 99 per cent, $18. (Usually sold as calcium molybdate or ferromolybdenum, which see).

NICKEL—Per lb., ingot 35c.; shot 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175 according to quantity.

OSMIUM—Per oz., $55@$65; London, £12@£14.

PALLADIUM — Per oz., $38@$40. London, £9 10s.@£10 10s.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $70. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less. Well-informed interests in the trade believe that prices have touched bottom at the present levels. Market firm.

London, per oz., £13 5s.@£14 5s., for refined; crude and scrap, nominal at £13@£13½. Market slow.

QUICKSILVER—Per 76-lb. flask, $118@$119. Small lots command the usual premium. Market very quiet. San Francisco wires $123.33 for retail and small wholesale lots. London quiet, with offers of spot at £22 5s.

RADIUM—Per mg. radium content, $70.

RHODIUM—Per oz., $40@$55. Nominal. London, £11@£12.

RUTHENIUM — Per oz., $45@$55. Nominal. London, £9@£10.

[1]SELENIUM — Per lb. in ton lots: Black, powdered, amorphous, 99.5 per cent pure, $2.25. London, 7s. 8d.@7s. 9d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 20c.; tantalum powder, 11c.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

[1]Price furnished by Foote Mineral Co., Philadelphia.

TUNGSTEN POWDER—Containing 97 to 98 per cent tungsten, per lb., $1.20@$1.35, depending on quantity. Nominal.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, $1.56 in 5- to 10-lb. lots.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.40 per short ton unit, c.i.f. New York.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $22 for 47 per cent Cr_2O_3 ore to $23.50 for 50@51 per cent ore. New Caledonian ore, high-grade, $25.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.25.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range, bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 8c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 10 @11c.

Spanish and North African basic, 50@60 per cent, 8½@9c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

Newfoundland foundry, 55 per cent, 8½c.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports. Exclusive of duty. Brazilian and Indian ores, minimum 47 per cent Mn, 34@35c. Caucasian (washed), 53@55 per cent, 37@39c. Market easy.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2. Brazilian and Cuban, $70@$80. Caucasian, minimum 85 per cent, $70. Montana, 70 to 75 per cent, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., 93 per cent concentrate, 10c. for 30-ton lots.

TUNGSTEN ORE—Per short-ton unit of WO_3, N. Y.: Wolframite, $11.70@$11.85. Western scheelite, $12@$12.50. Domestic sellers are hopeful of an advance in tariff and consequently are disinclined to quote on uncontracted scheelite at present prices.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS — Per ton: f.o.b. Quebec mines, tax and bags included, new prices quoted by leading interest for delivery on 1929 contract:

Crude No. 1, $550@$750; crude No. 2, $450@$575; spinning fibers, $225@$275; magnesia and compressed sheet fibers, $175@$225; shingle stock, $55@$115, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@$20; floats, $12@$15.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $6.50. Washed and water floated to 97 per cent through 300 mesh, $19. Demand continues steady at about 75 per cent of production capacity.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7.25@$7.60 f.o.b. mines. Market good.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.50@$8.25 f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.75@$8.25 f.o.b. *Arkansas* mines. Pulverized and dried, $12@$14 f.o.b. *Arkansas* mines; calcined, 78 to 84 per cent Al_2O_3, $18@$20 f.o.b. *Arkansas* mines. Better demand from abrasives, cement and other small consuming industries.

Per metric ton, foreign c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2¾c.; granulated or powdered, 2½c.; f.o.b. consumers' shipping point. Market good.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $8@$15; ground, $7@$10.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100 lb. bags (bags extra), No. 1, $20; No. 2, $17. Market fair.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $40@$45.

DIATOMITE—Per short ton, f.o.b. producing plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45; 80 to 85 per cent silica, 98 per cent through 200 mesh, $20 in carload lots.

EMERY—F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 6½c.; domestic, 3½c. Market good.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6.50@$8.50; glass grades, $5@$6. Market good for No. 1 grade, fair for No. 2.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25; 90 mesh, $12; 140 mesh, $13.75; 200 mesh, $15.50. No. 3, 20 mesh, $9. Market improving.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $9.

New York, per ton: f.o.b. cars, No. 1 crude, $9. Market fair.

Maine, per ton: Best pottery grade, ground, $19. Market fair.

FLUORSPAR — Per ton: F.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Domestic offerings are limited pending hoped-for additional upward tariff revision.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 94-3 lump, $21; 96-3 100-mesh, $30. Market good.

Foreign spar, duty paid, $19.40, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7. Market fair.

Powdered, import duty paid, $24@$25 per ton.

GARNET—Per ton; domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado*.

Selected grade, $33; seconds (mine run), $25.50. Normal market.

GRAPHITE—Per lb., f.o.b. *New York:* Ceylon lump, 7½@8½c.; chip, 6½@7½c.; dust, 2½@5c.; Madagascar flake, 6½@7½c.

No. 1 flake, 8c. and up. No. 2 flake, 6c. and up. Foundry facings, 3c. and up. Graphite facings, 4c. and up. Amorphous and crystalline, fine ground, 4c@8c. Foreign market somewhat stronger for Ceylon grades.

Crude amorphous graphite, $15@$35 per ton, according to grade. Demand slightly improved.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $20. Market quiet at this season.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.70@$6; ground, $4@$9; agricultural, $4@$9; calcined, $4@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$3.

Agricultural, 40c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $43; Grade B, $40; dead burned, $29; crude, $11; high-purity periclase, f.o.b. Eastern seaboard, calcined, $40. *Washington:* Dead-burned magnesite, $22@$24 per net ton, Chewelah, Wash.

MICA—Per ton, f.o.b. plant:

New Hampshire: Mine run, $250; clean shop scrap, $25; roofing, $23. White dry ground, 20 mesh, $28; 40 mesh, $38; 60 mesh, white, $60; off-color, $34; 100 mesh, $70; 200 mesh, $80. Granite-mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 10 mesh.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, per lb., f.o.b. *New York*, duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $130.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground, 90 per cent through 200 mesh, 33 per cent P_2O_5, $11.20 per short ton. Brown lump for acid manufacture, per gross ton, $6 on 75 per cent basis; $5.25 on 72 per cent basis. Non-acidulated, fine ground, 65 per cent, $8 (per short ton). Prices firm, active demand for fertilizer and furnace trade, general outlook for 1929 is excellent.

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent	21.75	18.75
Manure salt 20 per cent	15.40	12.40
Kainit 14 @ 16 per cent	12.50	9.50
Kainit, 12.4 per cent	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: C.i.f. United States ports; guaranteed 48 per cent sulphur: Spanish, 13c.: Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers. Market very slow.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. For optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50. Market fair.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Open prices $1 to $3 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9@$9.50; 97½ to 98½ per cent through 200 mesh, medium white, $8.50@$9; packed in 50-lb. paper bags; prices $1 per ton less in burlap sacks plus 15c. net for bags packed 12 to the ton. Market weak, with keen competition.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75. Market fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10@$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Demand better than average for the winter season.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 15½c. per lb.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c.; delivered near by. Market firm. London, per long ton, £16½ quoted for Cornish white; Mexican high grade, £17 5s., c.i.f. Liverpool.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5.65c., for either large or small crystals.

SODIUM NITRATE—Per 100 lb: crude, in bags ex vessel, Atlantic ports, $2.17½ for spot; future delivery, $2.22½.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $15@$20; in barrels, $21@$23.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Alloys

[1]FERROCERIUM—Per lb., $7 in 15 to 75 lb. lots.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c. Freight allowed in carload lots east of Mississippi River and north of Baltimore.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $105. Spiegeleisen, 19@21 per cent, $33@$34 on carload business, f.o.b. furnace.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.20. Firm.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 15@17 per cent, $45, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments $5@$10 per ton higher on 50 and 75 per cent grades. Market active.

FERROCARBONTITANIUM — Per ton: For 15 to 18 per cent material, $200, f.o.b. Niagara Falls, N. Y.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.04@$1.10, f.o.b. works. Market active.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed. $3.15@$3.50, depending on grade and quantity.

NICKEL SILVER—Per lb. for 18 per cent nickel Grade A sheets: Price advanced from 32c. to 32¼c. on Feb. 4, and from 32¼c. to 32½c. effective Feb. 5.

YELLOW (MUNTZ) METAL—Dimension sheets, per lb.: Price advanced from 22½c. to 22⅝c. on Feb. 4, and from 22⅝c. to 23c. effective Feb. 5; rods, per lb., price advanced from 19½c. to 19⅝c., Feb. 4, and from 19⅝c. to 20c. effective Feb. 5.

Rolled Metals

COPPER—Sheets, hot-rolled, per lb., price advanced from 26⅛c. to 26½c. on Feb. 4, and from 26½c. to 26¾c. effective Feb. 5; wire, per lb., f.o.b. mill, price advanced from 18⅞c. to 19⅛c. Feb. 1, and from 19⅛c. to 19⅜c. effective Feb. 5.

LEAD SHEETS—Full rolled, 10½c. per lb.; clipped, 10¾c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS — Per lb., 9¾c., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $52.

ZIRKITE—Per lb.; Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1928	1929	1928	1929	1928	1929
January	57.135	57.019	26.313	26.257	487.098	484.577
February	57.016	.....	26.205	.....	487.008	.....
March	57.245	.....	26.329	.....	487.558	.....
April	57.395	.....	26.409	.....	487.785	.....
May	60.298	.....	27.654	.....	487.685	.....
June	60.019	.....	27.459	.....	487.565	.....
July	59.215	.....	27.262	.....	485.923	.....
August	58.880	.....	27.096	.....	484.979	.....
September	57.536	.....	26.440	.....	484.654	.....
October	58.087	.....	26.727	.....	484.584	.....
November	57.953	.....	26.704	.....	484.492	.....
December	57.335	.....	26.349	.....	484.698	.....
Year	58.176	.....	26.746	.....	486.169	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1928	1929	1928	1929	1928	1929
January	13.854	16.603	61.912	75.551	66.575	78.602
February	13.823	.....	61.670	.....	66.381	.....
March	13.845	.....	61.148	.....	66.443	.....
April	13.986	.....	61.678	.....	66.500	.....
May	14.203	.....	62.554	.....	67.216	.....
June	14.527	.....	63.664	.....	68.738	.....
July	14.527	.....	62.881	.....	68.670	.....
August	14.526	.....	62.472	.....	68.750	.....
September	14.724	.....	63.522	.....	69.800	.....
October	15.202	.....	65.524	.....	71.935	.....
November	15.778	.....	68.080	.....	74.750	.....
December	15.844	.....	69.336	.....	75.000	.....
Year	14.570	.....	63.703	.....	69.230	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1928	1929	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	6.500	6.650	6.280	6.498	21.773	22.213	22.111	22.344
February	6.329	.....	6.069	.....	20.283	20.747	.....	.....
March	6.000	.....	5.805	.....	19.938	20.352	.....	.....
April	6.100	.....	5.991	.....	20.306	20.563	.....	.....
May	6.123	.....	6.012	.....	20.483	20.813	.....	.....
June	6.300	.....	6.152	.....	20.985	21.211	.....	.....
July	6.220	.....	6.038	.....	20.602	20.957	.....	.....
August	6.248	.....	6.056	.....	21.634	21.628	.....	.....
September	6.450	.....	6.286	.....	22.050	21.769	.....	.....
October	6.500	.....	6.318	.....	22.082	21.796	.....	.....
November	6.389	.....	6.222	.....	21.239	21.469	.....	.....
December	6.495	.....	6.343	.....	21.342	21.730	.....	.....
Year	6.305	.....	6.131	.....	21.060	21.271	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1928	1929	1928	1929
	Straits		Spot	
January	55.650	49.139	253.222	222.727
February	52.440	.....	233.833	.....
March	52.220	.....	232.722	.....
April	52.270	.....	234.204	.....
May	51.582	.....	230.886	.....
June	47.938	.....	217.280	.....
July	47.040	.....	212.449	.....
August	48.012	.....	212.847	.....
September	48.073	.....	215.663	.....
October	48.966	.....	222.005	.....
November	50.750	.....	232.875	.....
December	50.185	.....	227.586	.....
Year	50.427	.....	227.131	.....

New York quotations, cents per pound. Quotations on 99 per cent tin discontinued on April 1, because of absence of business. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1928	1929	1928 Spot	1928 3 Mos.	1929 Spot	1929 3 Mos.
January	5.643	6.350	26.125	26.051	26.196	26.233
February	5.551	.....	25.518	25.506	.....	.....
March	5.624	.....	25.082	24.960	.....	.....
April	5.759	.....	25.493	25.316	.....	.....
May	6.026	.....	26.102	25.756	.....	.....
June	6.158	.....	25.664	25.429	.....	.....
July	6.201	.....	24.946	24.972	.....	.....
August	6.249	.....	24.540	24.713	.....	.....
September	6.250	.....	24.497	24.625	.....	.....
October	6.250	.....	24.030	24.296	.....	.....
November	6.263	.....	24.801	24.827	.....	.....
December	6.349	.....	26.609	26.615	.....	.....
Year	6.027	.....	25.284	25.256	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	10.863	9.558	123.620	119.481	79.280	70.000	69.280	60.000
Feb.	10.842	.....	121.370	.....	84.783	.....	74.783	.....
March	10.083	.....	122.557	.....	80.000	.....	70.000	.....
April	9.865	.....	123.740	.....	80.000	.....	70.000	.....
May	11.019	.....	123.173	.....	78.000	.....	68.000	.....
June	9.750	.....	122.423	.....	78.000	.....	68.000	.....
July	9.540	.....	121.260	.....	78.000	.....	68.000	.....
Aug.	10.181	.....	124.500	.....	78.000	.....	68.000	.....
Sept.	10.813	.....	128.000	.....	78.000	.....	68.000	.....
Oct.	10.841	.....	125.923	.....	78.000	.....	68.000	.....
Nov.	10.109	.....	123.000	.....	76.417	.....	66.418	.....
Dec.	9.748	.....	122.500	.....	74.480	.....	64.480	.....
Year	10.305	.....	123.506	.....	78.580	.....	68.580	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75-lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Valley[1], and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1928	1929	1928	1929	1928	1929	1928	1929
Jan.	17.50	18.00	17.00	17.50	17.25	17.50	24.300	24.300
Feb.	17.50	.....	17.00	.....	17.25	.....	24.300	.....
March	17.50	.....	17.00	.....	17.25	.....	24.300	.....
April	17.50	.....	17.00	.....	17.25	.....	24.300	.....
May	17.37	.....	16.38	.....	17.24	.....	24.300	.....
June	17.00	.....	15.56	.....	16.79	.....	24.300	.....
July	17.00	.....	15.75	.....	16.69	.....	24.300	.....
Aug.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Sept.	17.00	.....	15.75	.....	16.50	.....	24.300	.....
Oct.	17.24	.....	16.66	.....	16.74	.....	24.300	.....
Nov.	17.82	.....	17.32	.....	17.32	.....	24.300	.....
Dec.	18.00	.....	17.50	.....	17.50	.....	24.300	.....
Year	17.37	.....	16.56	.....	17.02	.....	24.300	.....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

	1928					
	July	Aug.	Sept.	Oct.	Nov.	Dec.
Domestic						
Alaska shipments	999	2,219	661	3,036	1,313	1,807
Calumet & Arizona	1,593	2,205	2,337	2,201	3,006	2,890
Magma	1,584	1,427	1,678	1,877	1,635	1,436
Miami	1,756	1,924	1,770	2,133	2,119	2,148
New Cornelia	2,989	3,673	3,230	3,190	3,340	4,143
Nevada Con.	.....	.....	†35,476	.....	.....	.....
Old Dominion*	819	968	818	840	943	804
Phelps Dodge††	8,193	9,330	7,892	10,054	9,080	10,361
United Verde Extension	1,793	2,027	1,757	2,065	2,133	2,344
Utah Copper	.....	.....	†35,858	.....	.....	.....
Tennessee Copper	541	594	594	621	639	558
Foreign						
Andes Copper	4,315	4,016	4,925	6,180	7,835	.....
Braden	9,079	8,234	8,193	9,265	10,438	.....
Boleo, Mexico	.....	.....	†3,053	.....	.....	†3,422
Bwana M'Kubwa	629	499	556	530	533	649
Chile	9,969	9,365	11,336	14,368	.....	.....
Furukawa, Japan	1,274	1,536	1,661	1,547	1,396	.....
Granby Cons., Canada	2,492	2,517	2,445	2,447	2,359	2,465
Howe Sound	.....	.....	†5,039	.....	.....	.....
Mount Lyell, Australia	.....	.....	†2 274	.....	.....	.....
Sumitomo Japan	1,611	1,643	1,677	1,466	1,562	.....
Union Miniere, Africa	10,820	10,775	10,248	10,120	10,174	9,440

†Three months. *Includes Arizona Commerical.
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1926		1927		1928	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	71,026	2,291	76,198	2,458	68,469	2,209
February	68,131	2,433	69,202	2,472	67,423	2,352
March	75,728	2,443	69,314	2,236	70,327	2,269
April	73,454	2,448	71,122	2,371	69,721	2,324
May	73,542	2,372	71,613	2,310	73,729	2,378
June	71,317	2,377	69,539	2,318	73,224	2,441
July	72,228	2,330	65,545	2,114	73,426	2,369
August	72,014	2,323	67,248	2,169	76,952	2,482
September	72,672	2,421	65,936	2,198	78,341	2,611
October	75,099	2,423	68,545	2,225	86,480	2,790
November	74,947	2,498	68,080	2,269	85,382	2,846
December	72,205	2,329	67,377	2,173	85,673	2,764
Total	872,509	.....	829,878	.....	909,147	.....
Monthly average	72,709	.....	69,165	.....	75,762	.....
Average of daily rate	.....	2,390	.....	2,274	.....	2,484

Mining Stocks—Week Ending Feb. 2, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	127⅛	121¼	126⅞	Ja. 2, Fe. 18 Q	1.50
Andes Copper	New York	51⅛	48	50⅛	No. 15, De. 17 I	0.75
Arizona Com	Boston	4½	4½	4½	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Aris	New York	130	122½	129½	De. 1, De. 17 QX	2.50
Cal met & Hecla	Boston	55½	51½	54½	Fe. 28, Mr. 30 Q	1.00
Cerro de Pasco	New York	107½	102½	106½	Ja. 11, Fe. 1 Q	1.25
Chile Copper	New York	92⅞	88⅛	92⅜	Mr.22, Ap.22 Q	0.87½
Con. Coppermines	N. Y. Curb	15	13⅛	14⅛		
Copper Range	Boston	28⅜	27½	28½	De. 15, Ja. 15	0.50
East Butte	Boston	4⅛	3½	4⅜	Dec., 1919	0.50
Granby Con	New York	90⅜	86⅛	89⅛	Ja. 4, Fe. 1 Q	1.00
Greene Cananea	New York	181½	170⅜	177	De. 1, Ja. 7 Q	1.50
Howe Sound	New York	71½	68⅛	70½	De. 31, Ja. 5 Q	1.00
Hudson Bay	N. Y. Curb	21⅜	20⅛	21⅛		
Inspiration	New York	49¼	46	48½	De. 20, Ja. 7 R	0.75
Isle Royale	Boston	27½	26	27½	Fe. 28, Mr. 30 X	0.50
Kennecott	New York	163	151½	160½	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	73½	67½	73⅜	De. 31, Ja. 15 Q	1.00
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅛		
Miami Copper	New York	36½	32⅜	36⅛	Fe. 1, Fe. 15 Q	0.50
Mohawk	Boston	48⅛	45½	46½	Ja. 26, Mr. 1 Q	1.50
Mother Lode	New York	3⅜	3⅛	3⅛	De. 14, De. 31 SA	0.20
Nevada Con	New York	48⅛	45⅜	47⅜	De. 14, De. 31 Q	0.50
New Cornelia	N. Y. Curb	43	40	41⅛	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	64⅛	59⅛	62⅜		
Ohio Copper	N. Y. Curb	4	2⅛	3⅛	Sept., 1926	0.03
Old Dominion	Boston	18⅛	17½	17½	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	270	210	268	De. 18, Ja. 2 Q	2.50
Quincy	Boston	48	45½	46	March, 1920	1.00
Roan Antelope	N. Y. Curb	49½	47	48½		
St. Mary's M. L.	Boston	39½	38	38	No.20, De.1 X	1.00
Seneca Copper	New York	6	5⅛	5⅛		
Shattuck Denn	N. Y. Curb	22⅛	21⅛	22		
Sherritt-Gordon	Toronto	8.10	7.95	8.10		
Tenn. C. & C.	New York	19⅛	18	19	Dec. 15, Q	0.25
United Verde Ex	N. Y. Curb	22⅛	20⅛	21½	Ja. 4, Fe. 1 Q	0.75
Utah Copper	New York	....	....	290	De. 14, De. 31 Q	3.00
Waite-Ack.-Mont	Toronto			2.35		
Walker Mining	Salt Lake	2.75	2.70	2.75		
Wenden Copper	N. Y. Curb	2⅛	1⅞	2		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	4	3⅜	3⅜		
Amer. Z. L. & S	New York	43	37⅜	42	May, 1917	1.00
A. Z. L. & S., pfd	New York	108	104⅜	105⅜	Nov., 1920	1.50
Bingham Mines	Boston	53	52⅜	52⅜	De. 20, Ja. 5 Q	0.50
Bunker Hill & S	N. Y. Curb	140	134½	140	Jan. 5, MX	0.75
Butte Cop. & Zn	New York	8⅜	8⅛	8⅛		
Butte Cop. Con	Boston Curb	1.00	*90	*95		
Butte & Sup	New York	10⅞	10½	10½	Dec. 31, Q	0.50
Callahan Zn-Ld	New York	3⅜	3⅛	3⅛	Dec., 1920	0.50
Chief Consol	Salt Lake	3.95	3.40	3.82	Ja. 10, Fe. 1 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	13⅛	12⅛	12⅛	Ja. 1 K	0.25
Constitution	Spokane	....	....	*36		
Dayrock	Spokane	....	....	1.60		
Dickens Consol	Spokane			*19		
Eagle-Picher	Cincinnati	21⅞	20⅜	20⅜	No. 15, De. 1 Q	0.40
Eagle-Pich., pfd	Cincinnati	....	....	110	Jan. 15 Q	1.50
Erupcion	Boston Curb	....	....	*29	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	*75	*61	*75		
Eureka Lily	Salt Lake	1.42½	1.40	1.42½		
Eureka Standard	Salt Lake	4.85	4.75	4.83		
Evans-Wallower	N. Y. Curb	21⅜	19½	21⅜		
Evans-Wal., pfd	N. Y. Curb	87	85½	87	Jan. 15, I	1.75
Federal M. & S	New York	290	265	290	Je., 1927	10.00
Fed. M. & S., pfd	New York	....	....	100⅜	No. 23, De. 15 Q	1.75
Gladstone	Spokane	....	....	*13½		
Golconda	Spokane	....	....	1.02		
Grandview	Spokane	....	....	*79		
Hecla Mining	N. Y. Curb	17⅛	16⅞	17⅛	No.13, De.14 Q	0.15
Highland-Surprise	Spokane	....	....	*15		
Jack Waite	Spokane	....	....	*20		
Kootenay Florence	Spokane	....	....	*22½		
Lucky Jim	Spokane	....	....	*24		
Lucky Tiger-C	Kansas City	†6.25	†5.75	.....	De.4, De.20 MX	0.12
Mexican Premier	Spokane			*97		
National Lead	New York	150½	146	150½	De. 14, De. 31 Q	1.25
Natl. Lead, pfd. A	New York	141½	140	140	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	120	118	128	Ja. 18, Fe. 1 Q	1.50
N. J. Zinc	N. Y. Curb	329	310	310		
N. J. Zinc, new	N. Y. Curb	82⅜	73½	80		
New Quincy	Salt Lake	1.45	1.40	1.40		
Noble Five	Spokane	....	....	*73		
North Lily	Salt Lake	8.25	7.95	8.25	Jan. 20 Q	0.25
Park Bingham	Salt Lake	14½	13	13½		
Park Utah	New York	12⅛	11½	12	De. 31, Ja. 2 Q	0.20
Pend Oreille	Spokane	....	....	14.25		
Rico Argentine	Salt Lake	*49	*46	*46	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	....	....	*58		
St. Joseph Lead	New York	88	76⅜	82	Ma. 8, Ma. 20 QX	0.75
Sherman Lead	Spokane	....	....	*22		
Silver King Coa	Salt Lake	13½	13½	13½	De. 15, Ja. 2 Q,	0.25
Silversmith	Spokane	....	....	*12	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	....	....	1.53	De. 20, BM	0.02
Tamarack-Custer	Spokane	....	....	*33	Sept., 1924	0.25
Tintic Standard	Salt Lake	14⅛	14⅜	14⅛	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	1⅛	1	1	Oct., 1925	0.05
Treadwell-Yukon	Toronto	12	11½	12		
United Zinc Smg	N. Y. Curb	2⅛	1⅞	2		
Utah Apex	Boston	4⅛	3⅞	4⅛	Je. 14, Au. 1 K	0.25
Utah Met. & Tun	Boston	1 1/16	1	1⅛	Dec., 1917	0.30
Whitewater	Spokane			1.20		
Yellow Pine	Los Angeles	*25	*10½	*10	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	9	8⅛	8⅞		
Barry-Hollinger	Toronto	*32	*27	*27		
Central Manitoba	Toronto	*70	*60	*66		
Coniaurum	Toronto	2.05	2.05	2.05		
Cresson Consol	N. Y. Curb	1⅛	*92	*97	Jan. 15, Q	0.02
Dome Mines	New York	10	9⅛	9⅛	De. 21, Ja. 21 Q	0.25
Golden Cycle	Col. Springs	†1.55	†1.53½	.....	No. 30, De. 10 Q	0.04
Gold Hill	Toronto	*7⅛	*5	*6		
Hollinger	Toronto	9.25	8.50	8.69	Fe. 8, Fe.25 M	0.05
Homestake	New York	74	73½	73⅜	Ja. 19, Ja. 25 MX	1.50
Kirland Lake	Toronto.	1.75	1.65	1.65		
Lake Shore	Toronto	21.00	19.50	20.25	De. 1, De. 15 QX	0.40
McIntyre-Porc	New York	21⅛	21	21	Fe. 1, Mr. 1 Q	0.25
Portland	Colo. Springs	†*17	†*12	.....	April, 1927	0.02
Rand Mines	New York	....	....	37⅛	Au. 21, '28 Am.Sh.	1.52
Siscoe	Toronto	1.40	1.35	1.35		
Sylvanite	Toronto	2.10	2.03	2.08		
Teck-Hughes	Toronto	9.25	8.75	9.00	Ja. 31, Fe. 1 Q	0.15
Tom Reed	Los Angeles	*15	*5	*5	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅛	1⅛	1⅛		
Vipond Consol	Toronto	1.15	1.04	1.06	April, 1927	0.03
Wright-Hargreaves	Toronto	2.25	1.94	2.20	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	33¾		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19	19	19		
Castle-Trethewey	Toronto	*40	*36	*37		
Cent. American	N. Y. Curb					
Consol. Cortez	N. Y. Curb	*37	*25	*37		
Dolores Esperanza	N. Y. Curb	1⅛	*90	1⅛	July, 1923	0.05
Keeley	Toronto	*60	*50	*50	Mr.15, 1928	0.04
Mining Corp.	Toronto	5.35	4.85	5.25	De.14, De.31 SA	0.15
Montana-Idaho	Spokane	9⅜	9⅛	9⅜		
N. Y. & Hond. Ros	N. Y. Curb	16½	16½	16⅜	Ja.16, Ja.26 QX	0.50
Nipissing	N. Y. Curb	3⅜	3⅛	3⅜	De.21, Ja.21 Q	0.075
Premier Gold	N. Y. Curb	2⅛	2⅛	2⅛	De. 14, Ja. 4 Q	0.06
Tonopah Exten	N. Y. Curb	*29	*12	*15	April, 1925	0.05
Tonopah Mining	N. Y. Curb	4	3⅜	3⅜	Se. 29, Oc. 20 SA	0.07½
United Eastern	N. Y. Curb	*99	*86	*89		
Yukon Gold	N. Y. Curb	1⅛	1	1	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	87⅛	82⅛	87⅛	Fe. 15, R	1.00
Beth. Steel, pfd, 7%	New York	123	122	122	Mr.4, Ap.1 Q	1.75
Cleveland-Cliffs	Cleveland	142	138½	140	Ja.15, Ja.25 QX	2.00
Colo. Fuel & Iron	New York	77⅛	71⅛	73⅛		
Colorado F. & I., pfd	New York	....	....	134	Fe.11, Fe.25 Q	2.00
Great Northern Iron	New York	39½	33⅜	37⅛	Dec.15, K	2.00
Inland Steel	New York	92	87⅛	90	Fe. 15, Mr. 1, Q	0.87½
Republic I. & S.	New York	86⅛	81½	86⅜	Fe. 13, Mr. 1, Q	1.00
Republic I. & S., pfd	New York	113⅜	112⅛	113½	Mr.11, Ap. 1, Q	1.75
Sloss-Sheffield S. & I.	New York	121	121	121	De. 15, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York	....	....	112	De.20, Ja.2, Q	1.75
U. S. Steel	New York	189½	179⅜	184⅜	Fe. 28, Mr. 30, Q	1.75
U. S. Steel, pfd	New York	....	....	141	Fe 2, Fe. 27, Q	1.75
Virginia I. C. & C.	New York	....	....	25	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	....	....	47½	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	184	173	182		
Alum.Co.of Amer., pf.	N. Y. Curb	106	105	106	Mr.15, Ap.1, Q	1.50
American Metal	New York	75⅞	68	75⅛	Fe.9, Mr.1 Q	0.75
Amer. Metal, pfd., 6%	New York	124½	122	124	Fe.9, Mr.1, Q	1.50
Amer. Sm. & Ref.	New York	120	113	119½		
Amer. Sm. & Ref., pfd.	New York	137⅛	135½	135½	Fe. 1, Mr. 1 Q	1.75
Amer. Sm. & Ref., new	N. Y. Cuab	....	....	114½		
Ang. Ch. Nitrate	N. Y. Curb	43⅞	39⅜	41⅞		
Asbestos Corp	Montreal	21⅛	19	20⅛	Jan. 1926	1.50
Asbestos Corp., pfd	Montreal	67⅛	66	66⅛	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	575	440	550	De.31, Ja.15, SAX	6.25
De Beers Consol	New York	22⅜	22⅛	22⅛	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	35⅛	33⅞	33⅞		
Freeport Texas	New York	53⅜	50⅛	51	Ja. 15, Fe. 1 Q	1.00
Int. Nickel Can., new	New York	69	62⅜	66⅜		
Int. Nickel, pfd	New York	120⅜	120	120⅛	Ja. 18, Fe. 1 Q	1.75
Newmont	N. Y. Curb	200⅜	191½	199⅜	De. 28, Ja. 15 Q	1.00
Patiño M. & E.	New York	38⅛	35⅛	37⅛	Aug. 1928	4s.
So. America G. & P.	N. Y. Curb	3⅛	2⅜	2⅜		
Texas Gulf Sulphur	New York	78⅜	76	77⅛	De. 1, De. 15 Q	1.00
U. S. Sm. R. & M.	New York	69⅜	65⅛	68⅛	De. 31, Ja. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	56	55⅛	55⅞	De. 31, Ja. 15 Q	0.87½
Vanadium Corp	New York	....	....	110⅛	Fe. 1, Fe. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Spokane Stock Exchange, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED JANUARY 22, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	14/—	13/9	13/9		
Alaska Treadwell (25)	60/—	50/—	55/—	Nov., 1926	4 (d)
Armayo Mines (25 frs.)	68/1½	65/—	66/3	Nov. 1928	5 (c)
Burma Corp (10 rupees)	18/10½	17/10½	18/6	Feb., 1929	7* annas
Bwana M'Kubwa (5s)	22/4½	16/3	22/4½		
Camp Bird (2s)	4/1½	3/9	3/10½	April, 1928	16⅛
El Oro (£1)	6/1½	5/7½	6/—	Nov., 1924	2½*
Frontino & Bolivia (£)	8/9	8/4½	8/9	July, 1928	3⅛
Mexican Corpn. (£1)	12/6	11/3	11/9		
Mexican Mines of El Oro (£1)	28/1½	24/4½	25/—	Dec., 1926	3⅛*
Mond Nickel	275/—	217/6	275/—	Feb., 1929	18½
Mount Isa (£)	41/3	35/7½	40/7½		
N'Changa Copper Mining	57/3	50/—	56/3		
Oroville Dredging (4s)	3/—	2/9	3/—	Nov., 1928	31½
Rhodesian Congo Border (£1)	100/—	77/6	98/9		
St. John del Rey (£1)	11/10½	11/4½	11/6	Dec., 1928	2½
San Francisco Mines (10s)	33/9	31/6	33/9	Jan., 1929	25
Santa Gertrudis (£1)	13/4½	12/6	13/11½	Jan, 1928	7½
Selukwe (2s. 6d.)	8/3	7/6	8/—	April, 1927	6½
S. Amer. Copper (2s.)	3/6	2/6	3/1½	Nov. 1917	75
Tanganyika (£1)	66/10½	63/9	65/—	July, 1928	5
Union Miniere de Haut-Katanga (Brussels)	11,700	11,525	11,600	July, 1928	182.60

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.